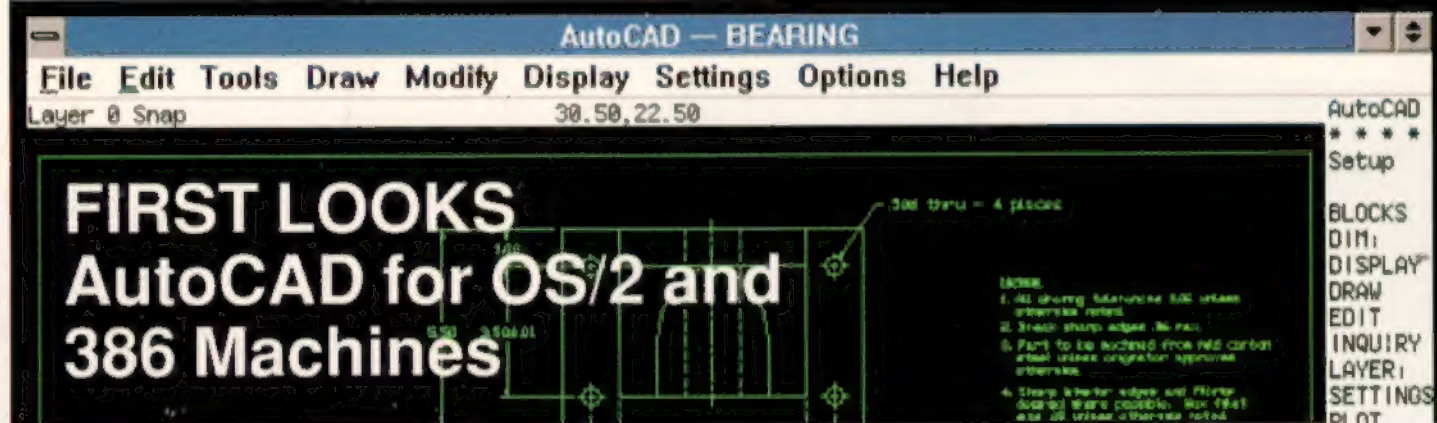




FIRST LOOKS AutoCAD for OS/2 and 386 Machines

MORE TAX SOFTWARE

**Are Home PCs
Deductible? Price
Waterhouse Explains
The New IRS Rules**

LAB NOTES

**6 Ways to Connect
Your Laptop to a
LAN, Mini, or
Mainframe**

VOLUME 9 NUMBER 5

THE INDEPENDENT GUIDE TO IBM-STANDARD PERSONAL COMPUTING

MARCH 13, 1990

PC Labs Tests

73 Powerhouse Portables

30 Do-Anything 386s

36 Workhorse 286s

7 Go-Anywhere
Notebook PCs



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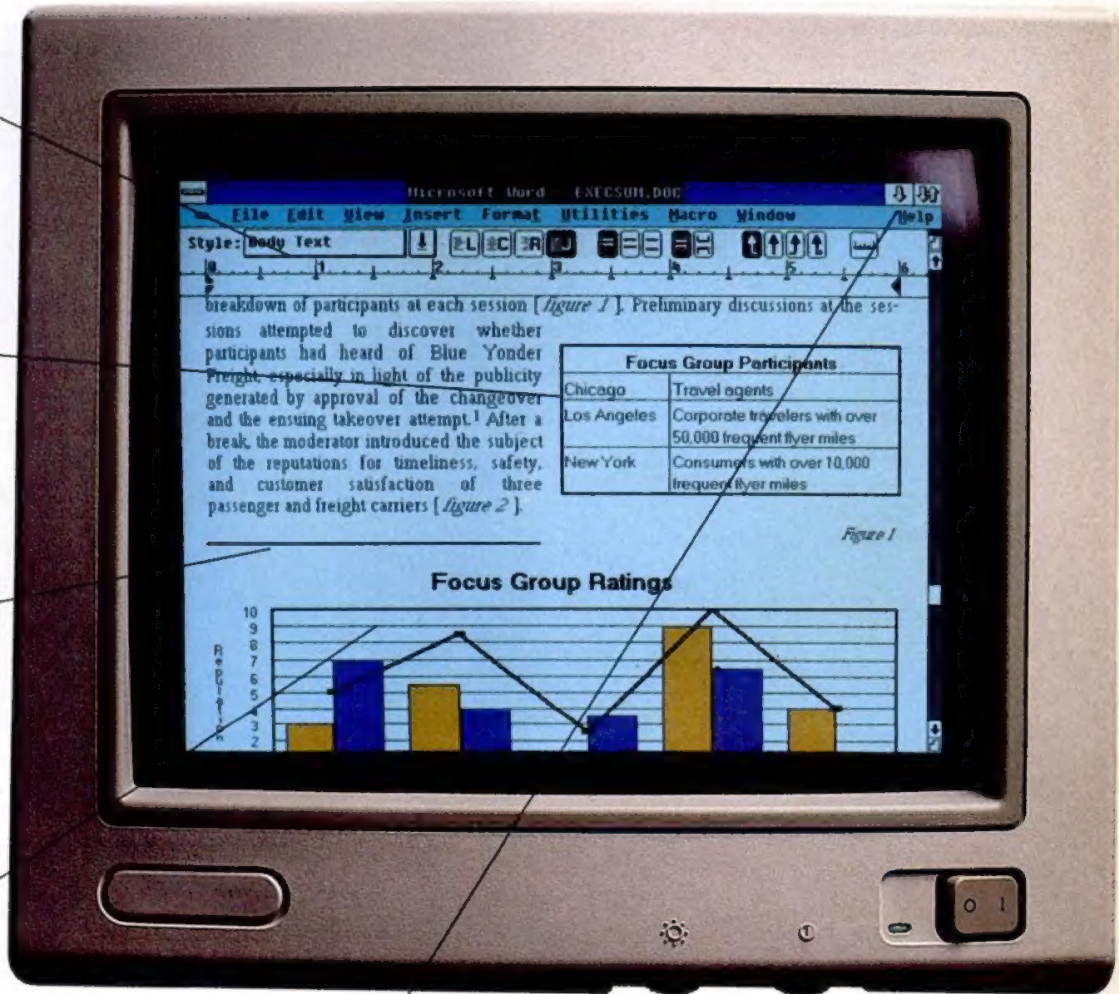
Manipulate words, paragraphs, tables, charts, graphs, and images right on screen, instead of a seemingly endless string of commands.

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Word for Windows even gives users a place to



ing out of complex complex part.

Market Survey and Ten-Year Growth Plan

Page 3

EXECUTIVE SUMMARY

BLUE YONDER AIRWAYS



Introduction

As Blue Yonder Airways moves from freight to passenger service, the Sales and Marketing Division is presented with a multitude of new challenges and opportunities. This report consists of a marketing proposal for the next ten years—a virtual blueprint for growth in our critical first decade as a passenger carrier. Our recommendations are based on data

resulting from a series of focus groups conducted by the market research firm of Crump & Graham. The growth plan makes specific suggestions for ways to leverage our track record in the freight arena, carve out our share of single-passenger bookings, and ultimately expand into group sales. A detailed analysis of costs and anticipated revenues is appended.

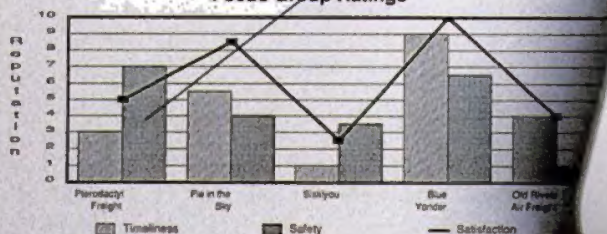
Research Overview

Crump & Graham held five focus groups between May and August of last year, two each in New York and Los Angeles and one in Chicago. The accompanying table shows the breakdown of participants at each session (figure 1). Preliminary discussions at the sessions attempted to discover whether participants had heard of Blue Yonder Freight, especially in light of the publicity generated by approval of the changeover and the ensuing takeover attempt.¹ After a break, the moderator introduced the subject of the reputations for timeliness, safety, and customer satisfaction of three passenger and freight carriers (figure 2).

Focus Group Participants	
Chicago	Travel agents
Los Angeles	Corporate travelers with over 50,000 frequent flyer miles
New York	Consumers with over 10,000 frequent flyer miles

Figure 1

Focus Group Ratings



Focus groups rate reputations of five U.S. carriers for timeliness, safety, and customer satisfaction.

¹ Participants were not aware that the focus groups were being held on behalf of Blue Yonder.

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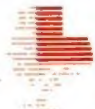
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CIRCLE 280 ON READER SERVICE CARD

Inside

No question about it: laptop PCs are hot. According to International Data Corp., the \$2 billion portable market will account for 13 percent of all IBM-compatible PCs sold in 1990, and 20 percent in just two years. In recognition of this trend, and in response to our readers' requests for more laptop coverage, *PC Magazine* presents the first comprehensive review of all portable PCs available today.

PC Labs staffers and our crack reviewers subjected 73 portables to rigorous testing for three months. What we discovered is that the days of the 30-pound, snail-slow, dim-screen portable are numbered. We look at machines ranging from the latest AC-powered 80386-based transportables to battery-powered 286 workhorses to the latest 7-pound notebook-style machines—diminutive engineering marvels that slip easily into your briefcase, and even into your pocket.

Associate editor Mary Kathleen Flynn, who was in charge of the editorial side of this project, points you to portable printers. Staff writer Catherine D. Miller examines different screen technologies so you can pick the laptop with the best video display for your needs. Executive editor John Dickinson and associate editor Jonathan Matzkin tell you how to organize your life by downloading your desktop to palm-sized electronic organizers and pocket computers such as the Casio B.O.S.S., the Sharp Wizard, and



the Atari Portfolio. And PC Labs director Frederic E. Davis even takes a gander at the Apple portable.

PC Labs' newest project leader, Abe Rosner, supervised the testing of each machine. Thanks to generous assistance from PC Labs' staffers, and because of the impressive credentials he brings to *PC Magazine*, Rosner's first project was a considerable success.

Rosner began as a programmer consultant at IBM. Later he developed TI-

GERS for the New York City Inspector General's office, a database now used nationally for tracking pending court cases.

Rosner's database expertise brought him to Information Builders Inc., where he did quality-assurance testing on multi-user databases.

Although nothing, he notes, could have prepared him for the hoard of portables that awaited him at *PC Magazine*, Rosner was very pleased to see the new breed of mobile PCs is ready to handle any computing challenge.

This new computing mobility translates to good news for all—from engineers who need on-site CAD capabilities to executives who need to issue on-the-fly directives without carrying an extra bag onto the plane.

And what about your needs? Read on. If there's a portable out there for you, we're certain that you'll find it in here.—Tom Unger



First-time project leader Abe Rosner supervised the testing of all 73 portables reviewed in this issue of *PC Magazine*.

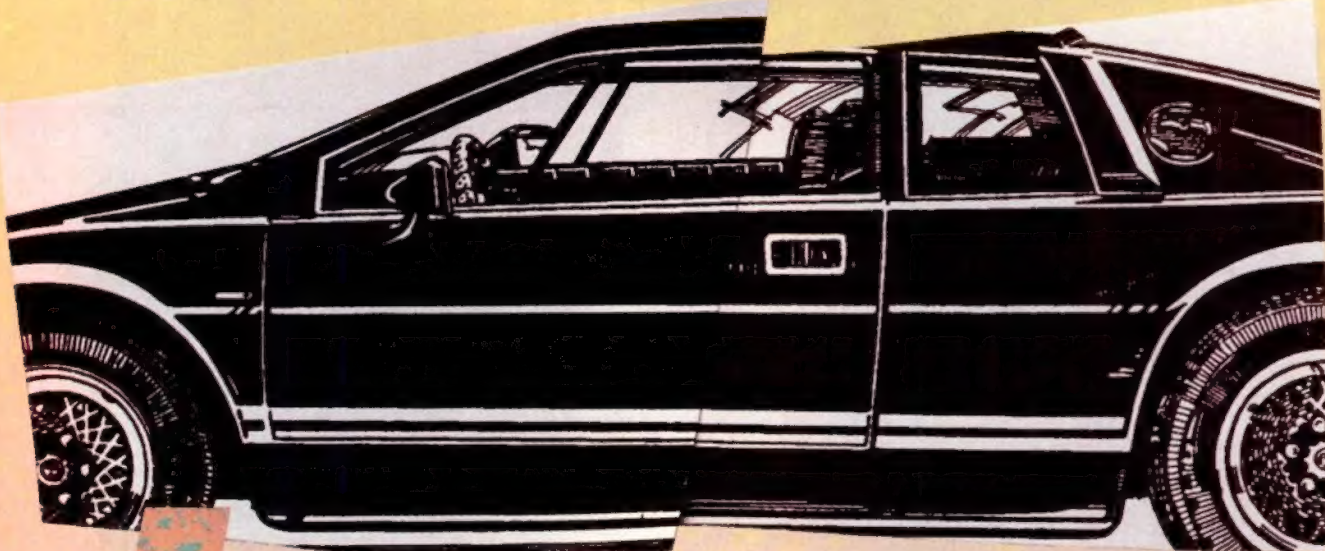
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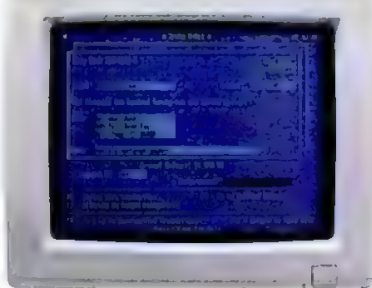
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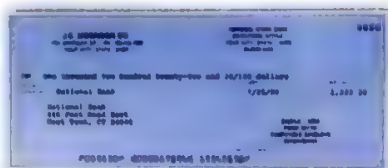
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The Editor's Choice for the '90's: The Austin 386/SX



January 30, 1990

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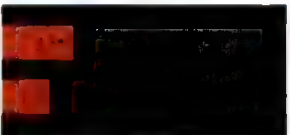
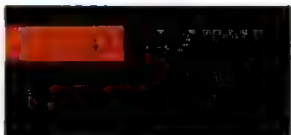
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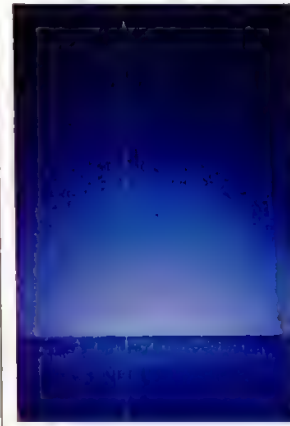
			
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*MIPS benchmarks based on The Database Group Power Meter MIPS version 1.2

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Actually, a lot of people tried. But what they ended with were a bunch of fancy software "environments" that eat up memory, change the way you work, and boggle the mind with complexity.

Plus, a lot of them make you buy new "compatible" software applications. Some even make you buy a bigger computer.

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Letters

■ BENCHMARK TESTS, ANYONE?

While it offered an excellent overview of the features described in the documentation, your review of low-end integrated programs ("Integrated Software Gets It Together," *PC Magazine*, December 26, 1989) overlooked a critical aspect of any software package: the rate at which it performs computation-intensive operations such as block moves and spreadsheet recalculations.

This issue is especially significant to readers who have become accustomed to a desktop 286 or 386 computer but who are also selecting software for use on an 8088 laptop. A tightly coded program can perform well on a machine that would be intolerably slow if running carelessly written software.

Your concern with speed is evident in your hardware reviews, but software design is also an important factor in determining overall system performance. In reviews of single-purpose software, you usually compare execution times for a representative subset of supported operations; such information is at least as important in the case of low-end integrated packages.

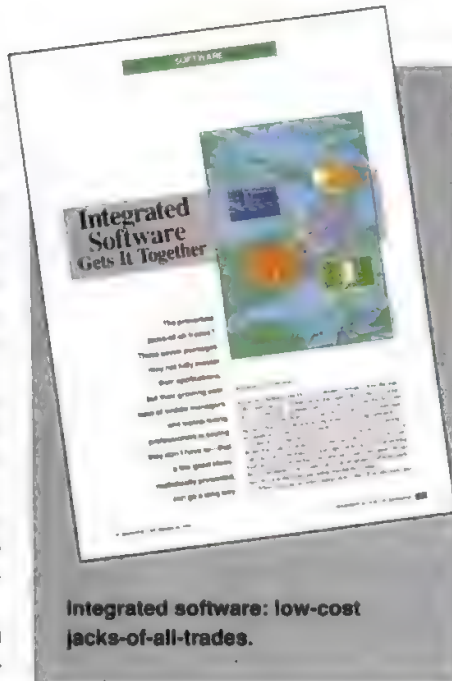
Charlie Cheney
Wrentham, Massachusetts

■ HEALTH AND THE PC

I was extremely impressed with Winn L. Rosch's article on the safety of the PC workplace (Lab Notes, *PC Magazine*, December 12, 1989). With this feature and your plans to report on the long-term reliability of equipment, it seems that you are positioning *PC Magazine* to be the complete PC buyer's guide.

As one who has a college background in science and a professional background in health, it is important for me to balance my technological needs with my health needs. I am happy to see you providing the information I need to maximize my personal health along with the "health" of my PC investment.

Howard Nemerov
Mill Valley, California



Integrated software: low-cost jacks-of-all-trades.

As a practicing optometrist, I read with interest your recent article on the potential effects of personal computers on the health of users. One effect not mentioned, but seen almost daily in my office, is increasing nearsightedness (myopia) shortly after the onset of computer use. Generally I see this in women, aged 20 to 40, who have had stable eyes for several years. Increases of .50 to 2.00 diopters are not uncommon.

Craig S. Steinberg, O.D.
Van Nuys, California

Thanks for your article about health and the PC environment. It's refreshing to see a discussion of some of the broader consequences of the PC revolution.

Along these lines, there's another issue that you'd do well to investigate—the environmental effects of manufacturing PCs and their components. There have been various reports of workers getting sick from the chemicals used in chip production and of ground and water pollution in Silicon Valley.

The December 1989 issue of *Mother Jones* reports that the chlorofluorocar-

bons used in the electronics industry destroy ozone in the atmosphere, and that the electronics industry has known this for a long time yet has done nothing to prevent it. I urge you to cover these and similar issues.

William Meacham
Austin, Texas

■ VOICE TALE

John C. Dvorak's editorial on computerized voice mail in the workplace (John C. Dvorak, *PC Magazine*, December 26, 1989) really brings to life the saying "high tech, low touch." As the general manager of an upwardly mobile computerized machine shop, I would be the first to admit that the daily tasks of job scheduling and keeping track of customers' orders would be nearly impossible without the assistance of my 386 PC and my fax machine. Still, with all the advancements in office technology, personal communication is as critical as ever to maintaining good, sound business relationships.

About a month ago, I was shocked to find out that one of my suppliers had installed an automated voice mail system. During a phone inquiry, I was instructed to press almost every key on my phone pad in the quest to leave a message for a salesperson. My first attempt ended in the voice system locking up on me. On my second try, I did manage to stay on-line and was rewarded with the privilege of leaving a short message.

Two days later, a salesperson phoned me back with a quote. I asked him why his company had chosen to install a voice mail system, and he replied that the company was trying to find new ways to stay competitive in today's marketplace. I regretted to inform him that he was one day late and 10 percent too high in his bid. The company's attempt to be more competitive and offer its customers better service has failed in this buyer's opinion.

Good call, John.
Steve Butts
Rancho Cordova, California

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Letters

KEYSTROKER'S CRAMP: THE EXPERTS SPEAK

In the December 12, 1989, issue of *PC Magazine*, John Carpi wrote a very nice sidebar on carpal tunnel syndrome and its relation to key operators ("Keystroker's Cramp," page 237). Unfortunately, in the accompanying illustration, the label that reads "tendons (which flex fingers)" is in

With all the
advancements in
office technology,
personal
communication is
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fact pointing to a distal branch of the median nerve. Obviously, the nerves provide the sensation to the fingertips, and the tendons, which are not shown in the picture, do the movement. A small point, but certainly an important one for any of us who do surgery on the hand.

Keep up the information flow.

Neal Koss, M.D.

Torrance, California

In the illustration that accompanies the sidebar titled "Keystroker's Cramp" in your December 12, 1989, issue, the bones labeled "wrist bones (carpals)" are actually the radius and ulna. The carpal bones are not visible in the illustration at all since they are covered by the transverse carpal ligament.

Basically, carpal tunnel syndrome is the compression of the median nerve at the wrist. Symptoms include pain, which commonly occurs at night, and numbness; both sensations may be poorly localized. Pain may reside in the hand or

radiate to the arm or shoulder.

Treatment is usually conservative and consists of anti-inflammatory medications and the use of splints. The earlier treatment is begun, the better the chances of avoiding permanent damage.

Arthur P. Barletta, M.D.

Robert A. Levin, M.D.

Washington, D.C.

SOUTHPAW ADVANTAGE

Your recent article evaluating PC keyboards ("Wanted: More than Just a Replacement," *PC Magazine*, December 12, 1989) has driven me to my first-ever "letter to the editor."

Those reviewers who commented on the 84-key versus the 102-key standard keyboards only in terms of technical progress are guilty of a serious oversight. As a user of *WordPerfect* (with Versions 4.2, 5.0, and 5.1 up and running), I must point out that the left-side function keys are a working necessity.

Alternatively, to teach the use of the standard IBM 102-key layout with *WordPerfect*, I find it convenient to encourage new word processing professionals to either grow a third hand or, more practically, take lessons on a Hammond organ as a training exercise.

My hat is off to Northgate for giving us the Omnikey Plus, which has 12, not 10, left-side function keys.

W. M. P. Dunne

Hampton Bays, New York

Thanks for the keyboard reviews in the December 12, 1989, issue. As a typewriter repairperson, I'd like to throw in my two cents on the question of keyboard "feel."

In the article, you mentioned the parameters of operating force and key travel distance. One more consideration is where "firing" occurs in the key travel. Back in the days of IBM Selectric typewriters, we would adjust the keyboard to fire somewhere between one-half and two-thirds of the way down. This would leave room for finger follow-through in each keystroke.

We would never adjust the keyboard so that the keys would have to be "bottomed" in order to fire. This really makes for operator fatigue (it's like tapping your fingers on a table top a few thousand times), as well as missed characters. The early Compaq 84-key keyboards are a great example of this—the keys have to be nearly bottomed to fire.

John Kwasnik

Oakland, California

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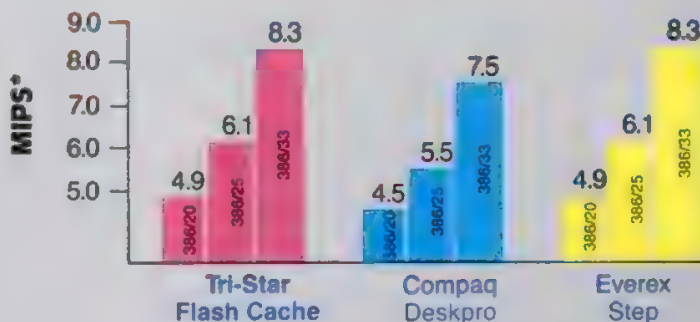
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Letters

ICY INTERFACE?

In the Letters column of the November 28, 1989, issue of *PC Magazine*, Fredrick Earl Upchurch calls for the renaming of the interface type he seems willing to use . . . provided it is rechristened.

The present name is graphical user interface, or GUI. Mr. Upchurch's objection is to the "pronounced" initials: gooey. Actually, the full phrase is a misnomer, and a fix is in order.

The name that captures the user's true relationship to the system is Interactive Cartoon Interface, or ICI (icy).

To use the standard
IBM 102-key layout
with *WordPerfect*,
it helps to either
grow a third hand or
take lessons on a
Hammond organ.

Incidentally, this new name reveals why Macs couldn't be given away in business settings until desktop publishing brought printing in-house. No executive over the age of 13 could sit through the demonstration of deleting a file by moving a mouse, clicking onto the icon of a file folder, dragging it to the icon of a waste basket, and clicking it in. Period. Execs like to give commands.

Are ICIs the wave of the future, or even a puddle of the future? Market shares seem to indicate not the near future.

Gene Fowler

Berkeley, California

NOT SO FAST

For the first time since I have been receiving *PC Magazine*, I have to write. In his December 26, 1989, column, William F. Zachmann states that mainframes and minicomputers will soon be dropped in favor of PCs. Admirable feeling, Will, but your faith is about as well founded as the

assumption that voice and electronic mail will eliminate paper in the workplace. Computers that are based on the Intel processors simply cannot handle the massive amount of data that even a \$250 million company must keep to remain competitive.

I read *PC Magazine* for personal as well as professional reasons, and I can tolerate the attitude that only the newest and fastest should be of concern. But the PC, as the name implies, is a Personal Computer. I wouldn't start selling my IBM and DEC stock just yet.

Jim Oberholtzer

New Berlin, Wisconsin

COMMAND-LINE MAGIC

I use dozens of utilities that I have collected over the years; in fact, I have most of *PC Magazine's* utility programs. But you have absolutely outdone yourselves with ALIAS (Utilities, *PC Magazine*, December 26, 1989). I have only just begun to tap the features of this utility. Keep up the good work. Your utilities alone are worth the price of the magazine.

Vern Semrad

Tampa, Florida

CORRECTIONS & AMPLIFICATIONS

The correct telephone number for The Complete PC, which makes The Complete Communicator (First Looks, *PC Magazine*, December 12, 1989, page 46), is (408) 434-0145. The correct telephone number for the Roland Digital Group, maker of the CAMM-1 Desktop Sign Maker (Stephen Manes, *PC Magazine*, December 12, 1989), is (213) 722-6933.

Contrary to what was reported in our features table, *Graph Plus*, Version 1.3, from Micrografx ("The Packages Behind the Presentation," *PC Magazine*, October 17, 1989), includes seven typefaces.

HOW TO WRITE TO PC MAGAZINE

Send letters to *PC Magazine*, One Park Avenue, New York, NY 10016, or upload to PC MagNet (see the "By Modern" sidebar in the Utilities column for access information). All letters become the property of *PC Magazine* and are subject to editing.

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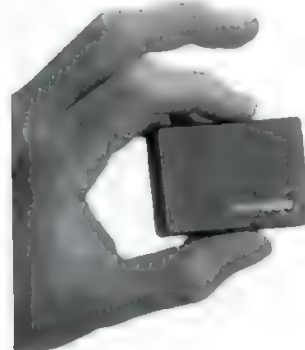
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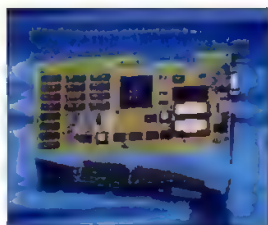
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by Lori Grunin

Advisor

ELBOW ROOM

I have a 286-based PC and have used *SPSS/PC+* with some success. Recently, however, I submitted a program and received a message that there was insufficient RAM available to run it. *SPSS/PC+* takes a significant amount of memory, and I don't use any other RAM-resident software that will take up any of the 640K necessary to run the program.

SPSS's technical support suggested that I buy software to reconfigure the video memory in order to make more RAM available for running the program. Could you suggest appropriate software for this purpose?

William W. Donald
Columbia, Missouri



A software utility called *Memory Master* (\$49.95; Vericomp, P.O. Box 23360, San Diego, CA 92123; (800) 876-0400, (619) 277-0400) has a module called EDOS that can give you an additional 96K of conventional memory, provided that you have a 256K EGA or VGA card. EDOS is an application loader, which means your application is a parameter for the EDOS command.

To use EDOS, you must reconfigure your applications for CGA graphics. When you load an application with EDOS, it confiscates memory addresses A0000 through B8000 (96K is normally used by EGA or VGA video), yielding 736K of contiguous conventional memory. In your case, this means that you can run *SPSS Graphics* and get printer output, but you won't be able to display graphics on-screen unless you turn off EDOS.

If you don't have the required video board setup but *do* happen to have a LIM 4.0 board that can map EMS memory into video memory addresses (Intel's Above Boards don't), the EEMRAM module will do the same as EDOS.

Another program that can remap video memory, but only if your system has a Chips and Technologies NEAT chip set and 1MB RAM or a hardware-capable

■ **ELBOW ROOM:**
Software that uses video addresses to buy conventional memory.

■ **THREE-FIGURE 3-D:**
An inexpensive CADD package with high-end 3-D capabilities.

■ **SCAN IN, FAX OUT:**
Scanners and fax boards for a growing business.

LIM 4.0 board with 256K, is called *Move'em* (\$89; Qualitas Inc., 7101 Wisconsin Ave., #1386, Bethesda, MD 20814; (301) 907-6700).

THREE-FIGURE 3-D

I am looking for a low-end 3-D CADD package that has dimensioning, text handling, solid modeling capabilities such as Bezier or spline curves, hidden line removal, the ability to export drawings for use in *PageMaker* 3.0, and a relatively friendly user interface. The package should also be able to run on my AT clone, which has an 80287 math coprocessor and 1MB of RAM.

W. S. Colwell
Delta, British Columbia
Canada



DesignCAD 3D, Version 2.1 (\$399; American Small Business Computers Inc., 327 South Mill St., Pryor, OK 74361; (918) 825-4844) seems to meet your criteria, and you should have no problem running it on your system. It can use your math coprocessor, and although it will run with 1MB of RAM, you may want to consider adding more memory (to use as expanded memory, which

the program supports) if you're going to be creating large or very complex images.

DesignCAD 3D can't do Bezier curves, but it does do cubic splines. And although it doesn't directly write DTP-ready files, the program comes with a utility that will convert your files to IGES, GEM, or PostScript format.

SCAN IN, FAX OUT

I am considering the purchase of a fax board or machine. I use *WordPerfect* on a 286-based system and need a unit compatible with the program. If someone sends me a hand-written fax, will the board be able to receive it and convert it to typed text? What are the pros and cons for a fax board versus a fax machine?

I also need to buy a scanner. I'd like to start with a hand scanner that can scan both text and graphics. Eventually, I would like to upgrade to a full-page scanner—specifically for text. Is there a hand scanner that I can start with, then later graduate to a full-page scanner that will use the same software? If not, which brands are my best alternatives?

Monica D. Kulesa
Carlstadt, New Jersey



Go directly to your collection of *PC Magazine* back issues (or local library) and read the story "PC to Paper: Fax Grows Up" (April 11, 1989). The article answers your question about the advantages and pitfalls of fax boards and fax machines and reviews 15 fax boards.

Then, check out *The Complete Fax/9600* (\$899; *The Complete PC*, 521 Cottonwood Dr., Milpitas, CA 95035; (408) 434-0145), a Group III fax board with a port for *The Complete Hand Scanner/400* (\$249), *The Complete Half Page Scanner/400* (\$299), or *The Complete Page Scanner* (\$899); it gives you the software consistency and upgrade path you desire, as well as saving a slot in your machine. The CFAX can work with other popular scanners as well, but then you need to use that

Advisor

scanner's adapter board. When you read the article, keep in mind that the CFAI didn't have the scanner port at evaluation time.

Although The Complete PC's line offers you an integrated solution, other individual products might be more suited to your needs. For fax boards, look into Intel PCEO's Connection CoProcessor (\$995; CO3-07, 5200 NE Elam Young Pkwy., Hillsboro, OR 97124; (800) 538-3373, (503) 629-7354. It's more expensive than the other boards, as well as less flexible. For instance, the board cannot operate with any scanners. But its on-board coprocessor lets it run true background communications, and you can get (free upon request from Intel PCEO) *Send-Off for WordPerfect*, a fax utility that may help you easily integrate faxing into your work environment. Along with the Connection CoProcessor, the JT-Fax 9600 (\$595; Q/Cor, One Meca Way, Norcross, GA 30093; (404) 564-5528) was our Editor's Choice in the April issue.

As for the ability of a fax board or machine to translate a hand-written fax into ASCII text—sorry, not yet. You can't even turn printed text into machine-recognizable characters without the aid of optical character recognition software. Remember, a fax is just an *image* of text stored in a graphics file format.

Most scanners can scan both text and graphics, although they don't necessarily perform both operations equally well. Some are optimized for dithering or gray scales, making them better for images; others are better at line art and text.

Aside from The Complete PC's scanners, you should look into the Niscan OCR Words & Pictures (\$495; Nisca Inc., 1919 Old Denton Rd., #104, Carrollton, TX 75006; (214) 242-9696), which gives you a lot of control over halftoning patterns when scanning graphics and comes bundled with OCR software. Or check out the Logitech ScanMan Plus (\$339; 6505 Kaiser Dr., Fremont, CA 94555; (415) 795-8500).

Hand scanners can be tricky, however, and it can sometimes take several passes to produce a clean scan of text or undistorted graphics. This is especially impor-

tant if you want to perform OCR. Also, you should try to project what your needs will be (hand versus page scanner), instead of waiting to see if the need arises. If you know you're going to be doing a lot of scanning, getting a full-page scanner might save you a lot of time and trouble; balance the extra cost of the full-page model against the opportunity cost of your time.

If you do opt for a full-page scanner, the Chinon DS-3000 (\$745; Chinon America Inc., 660 Maple Ave., Torrance, CA 90503; (800) 441-0222; last reviewed in the March 28, 1989, issue of *PC Magazine*) is a relatively inexpensive compromise with one drawback—the only fax card that operates with it directly is the JT-Fax 9600. You should also check out Hewlett-Packard's flatbed ScanJet Plus (\$2,190 with interface kit; 19310 Pruneridge Ave., Cupertino, CA 95014; contact an authorized HP dealer).

ASK THE ADVISOR

Send your questions to Advisor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column for access information). Please specify your equipment. ■

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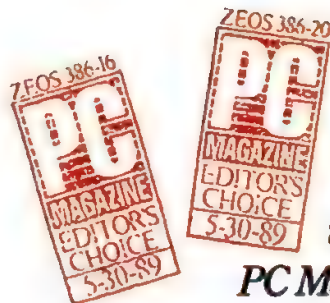
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PC Magazine, May 30, 1989

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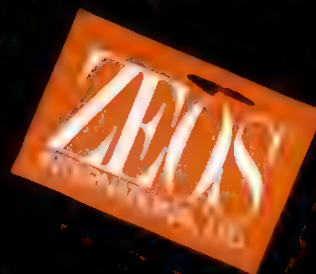
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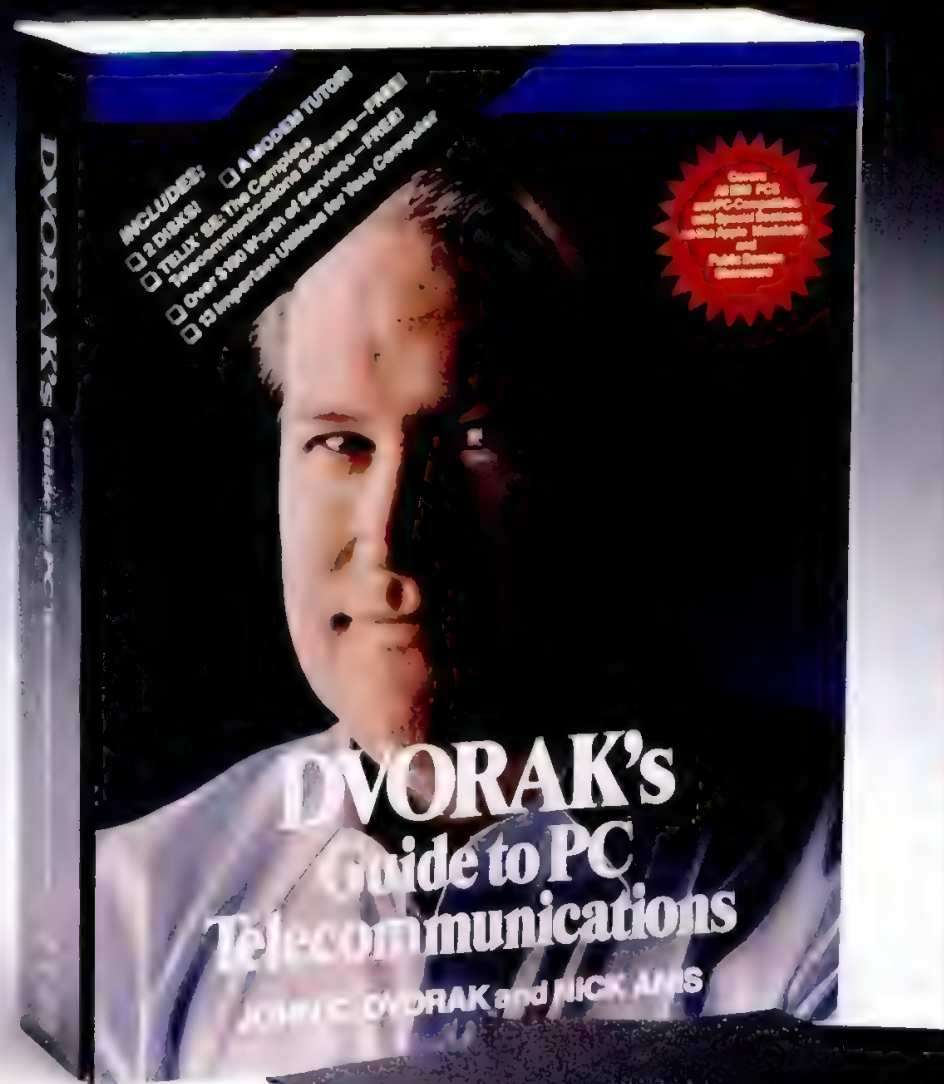
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by John C. Dvorak and Nick Anis • Foreword by Peter Norton

First Looks

Hands-on Reviews of the Latest Products

AutoCAD Smashes the 640K Barrier with Versions For OS/2 and 386 Machines

HANDS ON
by Jeff Prosser

AutoCAD 386 and *AutoCAD for OS/2*, Autodesk's most recent bids to advance the state of the art in PC-based CADD, use the latest in 286 and 386 technology to open the doors to protected-mode memory. The price you pay is RAM: *AutoCAD 386* needs at least 2MB (Autodesk recommends 4MB), *AutoCAD for OS/2* at least 4MB (the company recommends 6MB). But in the end, both programs free you from memory constraints and the need to maintain compatibility with 8-bit architectures that have throttled 286 and 386 machines since their introduction.

AutoCAD 386, a 386-specific version of *AutoCAD*, Release

10, uses Phar Lap Software's *386/DOS-Extender* to make up to 16MB of physical memory and 4GB of virtual memory available to the *AutoCAD* user. With the help of Phar Lap's *386/DOS-Extender*, *AutoCAD 386* runs in protected mode in memory beyond 1MB, leaving more room free in the base 640K for device drivers, TSRs, and networking software.

But ask Autodesk what is most significant about this new release, and the company will tell you it's not memory but speed. *AutoCAD 386* uses the 386's 32-bit instruction set and improved file-handling techniques to pare execution times down to the bare minimum. In addition, with memory above 1MB available as one huge linear address space, drawings no

longer have to be paged in and out to the hard disk (unless, of course, they become large enough to fill available memory), and *AutoCAD* itself can be run as one executable rather than as a series of overlays.

The result: outstanding performance. Autodesk claims that the 386 version will speed up typical drawing and filing operations by as much as 62 percent. That's not an exaggeration. *AutoCAD 386* removed hidden lines from a complex 3-D part model used in the PC Labs CADD benchmark tests in 50 percent less time than did *AutoCAD*, Release 10, running on the same 386—a performance improvement that extends to other areas of the package.

The performance of Autodesk's long-awaited Presentation Manager implementation, *AutoCAD for OS/2*, isn't quite as impressive. In the worst case, a drawing file that took 14 seconds to regenerate in *AutoCAD*, Release 10, took 21 seconds in *AutoCAD for OS/2*—more a result of Presentation Manager's Graphics Programming Interface than inefficiencies on *AutoCAD*'s part. On the other hand, *AutoCAD for OS/2* took the same amount of time to remove hidden lines from our 3-D part model as did Release 10 under DOS. OS/2 proponents will argue that the new version's gains in functionality far outweigh any performance penalties.

Among *AutoCAD for OS/2*'s most notable features are the ability to run one or more instances of *AutoCAD* in resizable



LaserPort 600
Brings 600-dpi PostScript printing to the HP LaserJet Series II 35

MultiMate 4.0
Goes from Wang clone to modern WP 36

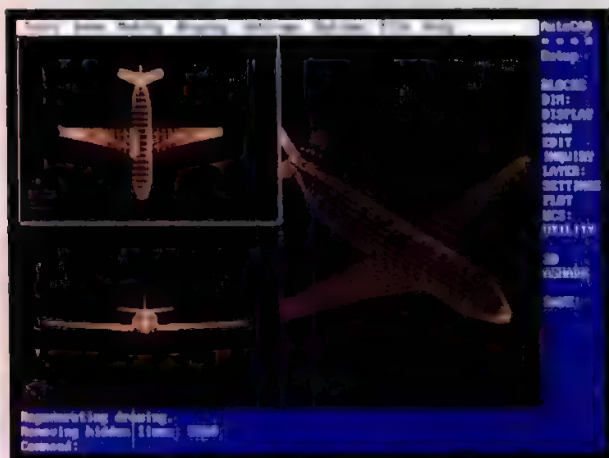
The Mace Utilities, Version 1990
New Emergency Room utility does hard-disk surgery 43

PopDrop Plus
Offers RAM-cram aid to TSR-laden PCs 44

Presentation Manager windows; the ability to access up to 16MB of physical memory, with de facto support for virtual memory in case you need more; compatibility with drawing files created in other versions of *AutoCAD*; the *AutoCAD* Development System (ADS), a new interface to the *AutoCAD* kernel that allows the program's power to be extended through user-supplied routines written in C and other high-level languages; support for Presentation Manager's Dynamic Data Exchange (DDE) facility, allowing live links to be established with other OS/2 application programs; and the ability to export graphics in raster or vector formats to other applications (or to other copies of *AutoCAD*) through PM's Clipboard.

By running multiple instances of *AutoCAD* (a feat that OS/2, with its smart memory-management techniques that let two copies of a program share one copy of the code, pulls off with little more memory than

CONTINUES ON PAGE 34



AutoCAD 386 uses the 32-bit features of the 386 to shorten the amount of time required to remove a hidden line. Displayed here are three views of a 3-D wireframe object.

First Looks

AutoCAD

CONTINUED FROM PAGE 33

that required to run a single copy of *AutoCAD*), you can plot a drawing from one window while editing it in another.

By virtue of *AutoCAD* for OS/2's support of DDE, you can exchange data with programs running in the background. For example, *AutoCAD* for OS/2 might run in one window and a spreadsheet in another, with the length of a shaft in *AutoCAD* linked to a cell in the spreadsheet. When the value in the spreadsheet changes, so does the length of the shaft. *AutoCAD* for OS/2 will find applications in parametric design as never before, allowing engineers to create what-if scenarios with their designs the way analysts do with their financial models.

One of *AutoCAD* for OS/2's most promising advances is the new *AutoCAD* Development System (ADS), a collection of libraries and header files for developing AutoLISP-like application programs in C or any high-level language that observes the C calling convention. To use ADS, you'll need Microsoft C 5.1, and if you want to use PM facilities, like windows and dialog boxes, you'll need a copy of the OS/2 Presentation Manager Toolkit.

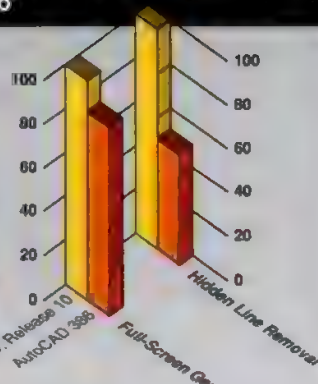


PERFORMANCE TESTS: AUTOCAD 386

AutoCAD 386 uses the 386's 32-bit instruction set and the CPU's ability to handle data in 32-bit chunks to optimize execution times. *AutoCAD*, Release 10, on the other hand, uses the 8088 instruction set in order to preserve compatibility with all members of the Intel family, and accesses memory only 16 bits at a time—even when it's run on a 386-based PC.

The **Full-Screen Generation** test measures the time it takes to redraw a two-dimensional .DXF file. Timing begins as soon as the first entity appears and ceases when the last entity has been completely drawn.

The **Hidden Line Removal** test measures how long it takes to



Relative Times
(AutoCAD,
Release 10 = 100)

remove multiple hidden lines from a 3-D model with almost 7,000 lines.

All tests were run under DOS 3.3 on a 20-MHz IBM PS/2 Model 70-121 configured with 6MB RAM, an 80387 math coprocessor, and a VGA display.

Performance Times (Times given in seconds)	Full-Screen Generation	Hidden Line Removal
AutoCAD, Release 10	14.00	238.00
AutoCAD 386	12.00	120.00

Once a program is compiled, it is loaded into *AutoCAD* with the new XLOAD command. Functions defined within the program become the equivalent of new *AutoCAD* commands, running in the *AutoCAD* shell and enjoying the same access to functions in the *AutoCAD* kernel as AutoLISP programs.

AutoCAD for OS/2 blends the look and feel of the old *AutoCAD* with the newer, sleeker look of the OS/2 Presentation Manager. Still, the transformation to the Presentation Manager interface isn't quite complete: the familiar *AutoCAD* menu still appears on the right-hand side of the screen, and although you can take it off, the pull-down menus at the top of the screen don't give you access to the full range of commands. In addition, many of the pop-up dialogue boxes invoked from the pull-down menus aren't Presentation Manager resources at all, but ported versions of the ones that appeared in Release 10. Still, they work, and there's just enough of the old and new to satisfy veteran *AutoCAD* users and OS/2 purists alike.

Like *AutoCAD 386*, *AutoCAD* for OS/2 needs lots of memory—a minimum of 4MB to be exact. But to avoid frequent disk accesses, you'll want 5MB or more. Autodesk recommends 6MB, which is enough to run multiple instances of the program without unnecessary



FACT FILE

Autodesk Inc., 2320 Mainship Way, Sausalito, CA 94965; (415) 332-2344.

AutoCAD 386

List Price: \$3,300; upgrade from Release 10, \$300.

Requires: 2MB RAM (4MB recommended); hard disk; 386- or 486-based PC; 80287 or 80387 math coprocessor; DOS 3.3 or later. Mouse or digitizer recommended.

In Short: A 386-specific version of *AutoCAD*, Release 10, that uses Phar Lap's 386/DOS-Extender to open up the vast expanses of 386 extended memory to DOS users and speed execution times with the 386's 32-bit instruction set and improved file handling.

CIRCLE 437 ON READER SERVICE CARD

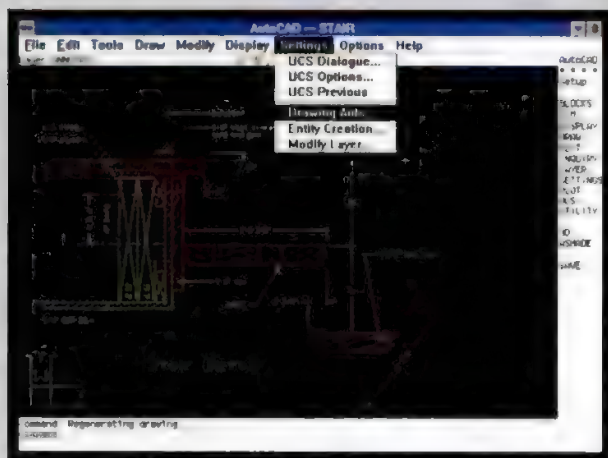
AutoCAD for OS/2

List Price: \$3,000; upgrade from Release 10, \$250.

Requires: 4MB RAM (6MB recommended); hard disk; 286-, 386-, or 486-based PC; 80287 or 80387 math coprocessor; OS/2 1.1 or later, Standard or Extended Edition. Mouse or digitizer recommended.

In Short: An OS/2 implementation of *AutoCAD*, Release 10, that blends the look and feel of the old *AutoCAD* with the newer, sleeker look of the Presentation Manager. Gives users access to as much memory as their machines allow. Offers a number of features not found in earlier versions, among them the ability to establish live links to other application programs and export graphics through the Presentation Manager's Clipboard.

CIRCLE 438 ON READER SERVICE CARD



Most *AutoCAD* for OS/2 commands are available through pull-down menus at the top of the screen. Those that aren't can be accessed from the menu at the right or typed in.

swapping. If you must make do with 4MB, consider eliminating the DOS compatibility box to maximize available memory.

The bottom line? If you run *AutoCAD* and own a 386 machine, the decision is a no-brainer: *AutoCAD 386* is a must. The \$300 upgrade fee from Release 10 will pay for itself many times over. If you run *AutoCAD* and don't already own a 386, this may be the best excuse you'll ever find to buy one. What about *AutoCAD* for OS/2? It's the best reason yet to justify the switch from DOS to OS/2.

First Looks

DP-Tek LaserPort PS 600: 600-dpi PostScript on a 300-dpi LaserJet Series II

HANDS ON
by Edward Menendez

If you have 5.5MB of spare RAM in your computer and an HP LaserJet Series II on your desk, DP-Tek's \$1,195 LaserPort PS 600 transforms your 300-dot-per-inch LaserJet into a 600-dpi PostScript printer. That's the same PostScript resolution as the slow-and-heavy \$16,995 Varityper VT600P—and you can still use your printer as a standard LaserJet when it isn't printing PostScript.

The LaserPort package contains hardware by DP-Tek and software by QMS. The hardware is a half-length expansion board that fits into any 16-bit slot, a small option board that plugs into the back of a LaserJet Series II, and a cable to connect them.

The software is *UltraScript PC Plus*, a PostScript interpreter that constructs the image of a page in your computer's RAM instead of in the printer's. It needs 4MB to build a 600-dpi page plus about 1.5MB for itself. QMS suggests using 7MB for better speed.

The combination produces some of the best output available with a LaserJet, equalled only by the latest LaserMaster

LX6 boards. Text and line art both have exceptional detail and clarity, far better than the 300-dpi output of the Apple LaserWriter, although not nearly as sharp as the 2,540 dpi of high-end typesetters. And the LaserPort board lacks the ability to improve gray scales in the style of the Intel Visual Edge.

The LaserPort and LaserMaster boards both work by modulating the laser beam to alter the size and shape of toner particles. A comparable technology is rumored to be part of a new Hewlett-Packard printer expected this spring.

The LaserPort board works with any software PostScript interpreter that has a driver for it. Only *UltraScript PC* has a driv-

er now, but a new version of Custom Applications' *Freedom of Press* will have one by the time you read this, and other programs will follow. Like *UltraScript PC*, the new *Freedom of Press* will let you print directly from your applications. If you already have *UltraScript* or want to use *Freedom of Press*, you can buy the LaserPort hardware for \$895.

Compatibility problems in *UltraScript PC* may make you seek an alternative. *UltraScript*'s installation program doesn't recognize any RAM-disks or caches in 80386-emulated expanded memory; this can cause frustrating lockups. QMS's tech staff didn't even understand the problem until I

Plug the LaserPort's half-length expansion board into your computer and its small option boards into your LaserJet Series II, and your printer will generate 600-dpi PostScript output.

sorted it out for them, but a fix is now in the works. Also, *UltraScript* could not print PC Labs' printer benchmark test files directly to the printer, so I had to print the test files to disk and send them to the printer separately.

With an 8-MHz AT, the graphics test took 3 minutes and 50 seconds to print—about one-fourth the time needed by the PacificPage PostScript cartridge in the LaserJet Series II, but with four times the resolution. PC Labs' 20-page text file, however, needed a patience-trying 1 minute and 15 seconds per page. Printing directly from an application requires similar times, because *UltraScript* takes full control of the CPU while it builds the page and doesn't leave any clock ticks free for your application. But because *UltraScript*, like other software PostScript interpreters, uses the CPU instead of its own processor, the timings would improve with a faster computer.

UltraScript PC Plus comes with the standard 35 PostScript fonts plus 12 varieties of the Lucida family of typefaces, but can't use Adobe soft fonts. *Freedom of Press* comes with 35 fonts and can use Adobe fonts. These and any other PostScript interpreter will look pretty good at 600 dpi, and only the LaserPort board gives you 600-dpi PostScript on your desktop.



FACT FILE

LaserPort PS 600

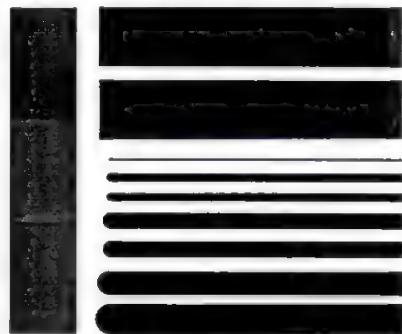
DP-Tek, 3031 W. Pawnee, Wichita, KS 67213; (316) 945-8600.

List Price: With *UltraScript PC Plus*, \$1,195; hardware only, \$895.

Requires: 80286 or 80386 CPU, 5.5MB RAM, hard disk with 4MB free, 16-bit half-length expansion slot, laser printer based on Canon SX engine, DOS 3.1 or later.

In Short: 600-dot-per-inch PostScript printing on a standard LaserJet Series II. The optional bundled software gives excellent output but can cause compatibility headaches.

CIRCLE 444 ON READER SERVICE CARD



The combination of DP-Tek hardware and QMS's *UltraScript PC Plus* software produces some of the best-looking text and line art available on a LaserJet.

Once you've torn down all of the laws in the country and you find yourself face to face with the Devil, what will you hide behind?
Courier **Bold Underline**
Palatino **Bold Underline Italic**
Helvetica **Bold Underline Italic**

First Looks

MultiMate 4.0 Evolves from Clunky Wang Clone to Modern-looking Word Processor

HANDS ON
by Edward Mendelson

After years of stagnation, *MultiMate* leaps into the 20th century. Version 4.0 of Ashton-Tate's \$565 word processor boasts virtually all the functions that today's electronic office uses for preparing documents, in a combination that isn't matched by any other package. *MultiMate* now comes with a grammar checker, integrated graphics editing, print preview, automatic import from other word processors, parallel and snaking columns, and electronic mail using Action Technologies' familiar MHS system.

Because all of *MultiMate*'s functions can now be accessed from clear pull-down menus, the battleship-size keyboard template of earlier versions has shrunk to a simple function-key chart. In place of the old flotilla of manuals, there's a single alphabetical guide. But the program still works much like the *MultiMate* of old. That's good news if your office is an entrenched *MultiMate* bastion and values consistency. It's bad news if you hoped the new *MultiMate* would stop making you work your way through giant menus before accomplishing anything or that it would shed enough of its clumsy editing and limited formatting to justify a switch from something else.

MultiMate works best if you use it in an office where word processing needs are limited to letters, reports, and simple mail-merge, using fixed-pitch printing with a daisy wheel or dot matrix printer. The program can handle more-complex documents and can manage a LaserJet or PostScript printer, but at the price of excessive effort and frustration.

If your office uses multiple word processors, *MultiMate* 4.0 can act as translator. It automatically imports (and optionally

exports) over 30 formats, including *WordPerfect*, *Microsoft Word*, *WordStar*, *Lotus Manuscript*, *OfficeWriter*, and *DCA*; further conversion filters are available from Ashton-Tate. You can import but not export 1-2-3 and *dBASE* files. I successfully imported and exported complex *WordPerfect* and *Word* files with footnotes, for-

of Bitstream's *Fontware*. Proportional laser output is a separate item on the print menu from ordinary printing. Once you choose it, you lose a lot of control over your file. The program automatically repaginates and hyphenates your text, and you can see the changes only on an uneditable preview screen. Hyphenation can't be turned off



MultiMate's pull-down menus allow access to all functions, including a built-in grammar checker.

eign characters, and format changes, although margins and tabs needed minor adjustments.

For graphics *MultiMate* uses a custom version of Inset Systems' *HiJaak*. You can create drawings with a mouse and overlay text in a variety of fonts. Or you can capture screens and import image files, then resize, rotate, or edit them. Powerful as these functions are, they are imperfectly integrated. When you insert an image into a file, you have to give it room to print by manually adding blank lines. To locate an image horizontally, you type tabs or spaces to the left of a code that contains its filename.

While rival programs edge into the desktop publishing field, *MultiMate* offers only primitive support for laser printers—although it includes a copy

with proportional printing, and you're limited to 60 footnotes per file.

MultiMate doesn't know which line height to use with proportional fonts, so you have to enter the number of lines per inch by hand. Worse, you can use only whole numbers, and the same number applies throughout the file. The manual actually suggests using superscripts and subscripts to adjust line positioning for headlines. The ordinary print menu lets you choose printers by name; the proportional output menu requires you to remember the obscure code names of your printer files.

One advantage of proportional printing is that the program repaginates automatically. With normal printing, you have to give a repagination

command after inserting text or footnotes—a requirement that doesn't belong in any modern word processor. You can't directly delete a page break, and you have to give a command in order to combine two pages. *MultiMate*'s screen is littered with obscure symbols and letters representing format changes—it's easy to confuse format commands with text.

MultiMate's thesaurus offers brief definitions, and the program uses Reference Software's *Grammatik IV* as a built-in grammar checker. You can tell *Grammatik* to test your prose against different sets of rules for Informal, Technical, Fictional, and other kinds of writing. It can either mark your file for later reference or display stylistic problems and give you a chance to edit them on-screen. (For a full review of *Grammatik IV*, see page 46 of this issue.)

For the legal market, *MultiMate* now offers line numbering, redlining, tables of authority, and a special legal dictionary, but *WordPerfect*'s legal features are easier to use and more extensive. If you want to use other programs from within *MultiMate*, you can build a menu of applications. Typical of the program as a whole, it can delete items from the menu, but they can't be modified or rearranged.

MultiMate 4.0 will gratify everyone who is too committed to the program to switch to anything else. If you've already switched, it offers no temptation to switch back. ■



FACT FILE

MultiMate, Version 4.0

Ashton-Tate, 20101 Hamilton Ave., Torrance, CA 90502-1319; (213) 329-8000.

List Price: \$565; upgrade, \$75.

Requires: 400K RAM, hard disk with 8MB free, DOS 3.1 or later.

In Short: *MultiMate*'s combination of advanced features is unique among current word processors, but its implementation is too awkward for Version 4.0 to be considered anything but an upgrade.

CIRCLE 448 ON READER SERVICE CARD

Scalable LaserJet Fonts for WordPerfect

Manuscript Century *Waldorf Script* Don Casual Eterna
Prestige Helvenica Buckingham *Coronation Script* PENWIN
Gibraltar Souvienne University Ornate Oxford Rockland
Letter Gothic **Copperfield** Garamand Helvenica Condensed Carnegie
Baskerton Classic Typewriter Obelisk Gettysburg Futuri
AvantGuard **AERO** GREEK AB\$% 01 *Exchequer Script* Katrina
Joulliard Zingbats "©" Tymes Roman New York Deco
Garamand Condensed Palatine Courier **Bongo Black**

Glyphix fonts install automatically in minutes and activate all of the font options in your WordPerfect (Ctrl-F8) font menu. Just select a font, a style and a point size from 3 to 120 point—you can even get effects like reverse, shadow and outline right from the menu. When you print, the Glyphix fonts you selected are generated automatically on-the-fly in just seconds.

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GLYPHIX REVIEWS ■ "... unlike anything else on the market—except possibly PostScript... produces remarkably fine type at amazing speeds." PC Magazine, June 13, 1989 ■ "... offers a combination of features and performance that is unavailable elsewhere. Like PostScript, Glyphix generates fonts from outlines, on the fly, and sends them to the printer as they are needed." Computer Buyers Guide and Handbook **AND USERS AGREE** ■ "Your approach to font generation is the right one—better than Bitstream, MoreFonts, Trionum, you name it." C.S. ■ "... I couldn't be happier with the quality, ease of use, and, most of all, printed output of this product." C.C. Massachusetts. ■

TECHNICAL REQUIREMENTS: IBM PC, AT, XT, PS/2 or compatible with a minimum of 512Kb RAM, a hard disk, MS-DOS 3.0 or later, a LaserJet Plus, Series II, IID, IIP or compatible printer with standard memory



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Zortech C++ 2.0 Developer's Edition Brings Programmers Up to Speed—Fast

HANDS ON
by Richard Hale Shaw

The leading C compiler vendors have battled over innovative development interfaces and code generation, but they've largely ignored C++. With its object-oriented programming (OOP) facilities, C++ lets you encapsulate program functions and data into objects that are easily maintained over a variety of diverse applications. With the \$450 Zortech C++ Developer's Edition V.2.0, C programmers

You shouldn't plan to use Zortech's product alone to learn C++, but you'll be tempted. The package provides only a brief introduction to the language, but it includes extensive C++ class libraries (replete with source code) for creating bit-based, dynamic, and virtual arrays and linked lists. There are also classes for managing binary trees and hash tables and for creating critical error handlers, event queues, and windows. Coupled with an impressive C function library that lets

lete", ",", and "new" operators, uses C++ 2.0 multiple inheritance, and offers type-safe linkage—the ability to type-check function arguments across separately compiled object modules.

Unlike the original AT&T C++ preprocessor, Zortech generates object code directly from any C or C++ source file. The compiler can produce CodeView-compatible debugging information so that you don't have to use it with the Zortech source code debugger. A command-line switch is available to generate Windows code, and a \$150 upgrade is available for OS/2: this includes an OS/2 compiler and libraries (but no debugger) that are virtually identical to their DOS counterparts. While the compiler supports the standard memory models, the installation program is less forgiving: since you can't selectively install specific memory models, you'll have to manually delete unneeded libraries.

Unlike Microsoft C 5.1, Zortech C++ 2.0 does not provide local and default optimization. Instead, a global optimizer can be invoked after you've finished developing and testing a program. As you'd expect, adding global optimization can double or triple compile time. But when compiling the *PC Magazine* C compiler benchmark test files, I saw only a .2-percent drop in the executable code size (the .OBJ files got bigger), and a performance improvement of 3 percent. Plus, the optimizer can't handle certain large functions that aren't a problem for Microsoft C 5.1 and Turbo C 2.0. Without optimization, it compiles as fast as Turbo C and at least as fast as Microsoft C with optimization turned on. Across the board, programs compiled with Zortech C++ 2.0 executed on a par

with the other two compilers.

The Zortech Developer's Edition includes ZDB, a windowing, CodeView-compatible source code debugger. It offers full support for 43/50-line EGA/VGA display modes, dual-monitor usage, and a mouse. You debug C, C++, assembler, or a mixture of all three and set breakpoints, watchpoints, and tracepoints. The interface provides movable, sizeable windows for displaying your program's source code, local function variables, global variables, C++ classes, and more. You can set timer breakpoints and use breakpoint and tracepoint counters. There's also a line-execution counter for profiling and optimizing your code. Like many hardware debuggers, ZDB uses a CRC to let you detect writes to a specified memory block. And it uses EMS (if available) to store debugging information, freeing program memory.

Zortech C++ is truly a fine compiler. I'd like to see more example code provided that makes more-extensive use of the C libraries and C++ class libraries. But, if you've been waiting for a major player to offer a professional's C++ development system for OS/2 and Windows, as well as DOS, wait no longer—Zortech has it. ■



can acquire a professional C++ development system for DOS, Microsoft Windows, and even OS/2.

If you're not familiar with C++, you're in for a treat: a superset of C that lets you create your own data types (called objects), C++ makes it easier to conceptualize, implement, and maintain an application. You don't write procedures that use diverse data structures in C++; you create generalized objects whose properties include them. Once you define an object class, you progressively define new ones that inherit the properties of one or more base classes. Your programs don't call functions, but notify an object of an action to take—the objects hide the specifics from you. The result? Shorter, easier, and more-maintainable programs.

you add EMM, mouse, graphics, and paged memory support to your programs (as well as facilities to create pop-up utilities), the package includes nearly everything you'll need to write complex applications in C or C++. With a good C++ instructional text in hand, you can start writing object-oriented applications in no time.

The 2.0 compiler offers a number of improvements over 1.07: The full-screen editor offers a CUA text-mode interface with mouse support; you can compile and debug programs from the Editor; and 2.0 programs don't have to be patched after linking. Where 1.07 wasn't a polished, professional product, 2.0 is. The Zortech compiler now recognizes private and protected keywords, permits overloading of the "de-



FACT FILE

Zortech C++ V.2.0 Developer's Edition

Zortech Inc., 1165 Massachusetts Ave., Arlington, MA 02174; (617) 646-6703.

List Price: \$450; compiler and editor only, \$199; OS/2 upgrade, \$150

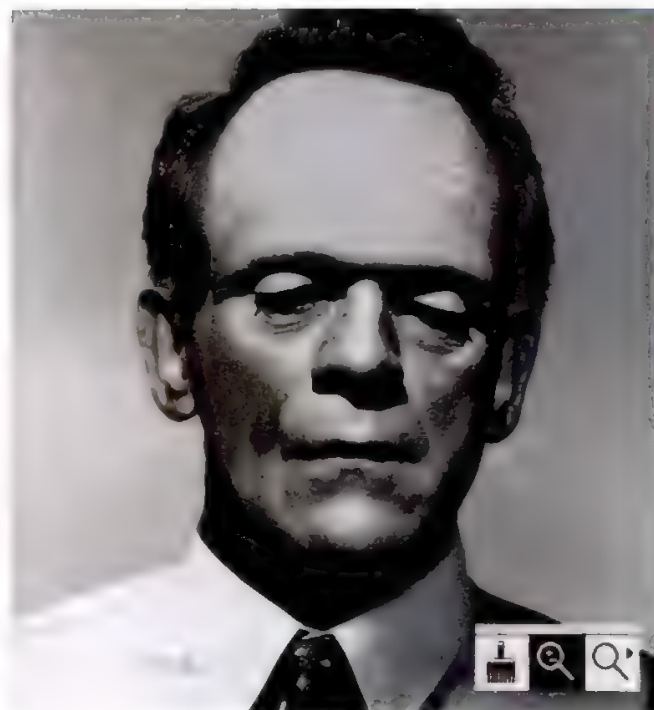
Requires: DOS version: 640K RAM, two disk drives (hard disk recommended), DOS 2.0 or later. OS/2 version: 4MB RAM, hard disk recommended, OS/2 1.0 or later.

In Short: Zortech offers a professional C++ development system for DOS, OS/2, and Windows, with full-screen editor and CodeView-compatible windowing source code debugger. C++ class libraries and an extensive C function library make this a very easy way to get started fast with C++.

CIRCLE 450 ON READER SERVICE CARD

XEROX

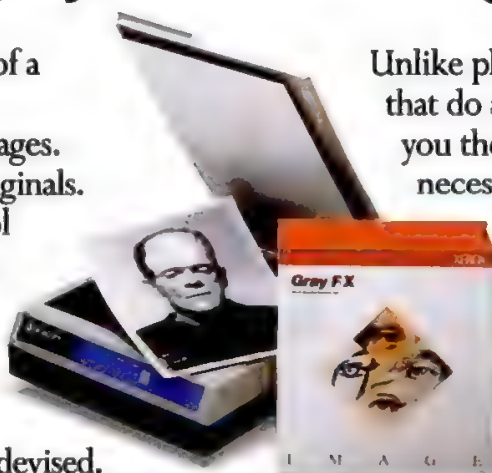
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CIRCLE 247 ON READER SERVICE CARD

When PC Magazine searched for words to describe Acma, they chose... Impressive! Performance! Our Favorite!

PC Magazine Review November 28, 1989



Mini Case



Standard Case



Standard Case



Vertical Case

PC Magazine reviewed 25MHz 80386 computers and called our's their "favorite." They praised our Cache computer for "...its performance, good expansion possibilities, 45-day money-back guarantee, and a two year warranty," and proclaimed "This is an impressive machine."

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286/16

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- Parallel, serial & game ports
- Clock calendar w/battery back-up
- Enhanced 101-key keyboard
- User's Guide & "Easyview" stand
- MS/PC-DOS, OS/2, Unix, Xenix and Novell compatible.
- Standard case (Vertical case \$175)
- 2 year warranty

Commercial leases start at \$56/mth.*

With Monitor & Video Board	Mono	EGA	VGA
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120MB/28ms	\$2,499	\$2,799	\$2,899

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- Supports EMS/LIM 4.0
- Supports 80287, 80387 and Weitek math coprocessors
- Eight expansion slots offer tremendous growth
- 200W UL, CSA & TUV approved power supply (110/220V)
- Built-in ROM based setup
- 1.2MB or 1.44MB floppy drive
- High performance 1:1 interleaved dual hard/floppy drive controller
- Parallel, serial & game ports
- Clock calendar w/battery back-up
- Enhanced 101-key keyboard
- User's Guide & "Easyview" stand
- MS/PC-DOS, OS/2, Unix, Xenix and Novell compatible.
- Standard case (Vertical case \$175)
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Commercial leases start at \$72/mth.*

With Monitor & Video Board	Mono	EGA	VGA
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- 0 wait state
- Shadow RAM for lightning-fast system & video BIOS relocation
- Supports EMS/LIM 4.0
- Supports 80387 and Weitek math coprocessors
- Eight expansion slots offer tremendous growth
- 200W UL, CSA & TUV approved power supply (110/220V)
- Built-in setup and diagnostics
- 1.2MB or 1.44MB floppy drive
- High performance 1:1 interleaved dual hard/floppy drive controller
- Parallel, serial & game ports
- Clock calendar w/battery back-up
- Enhanced 101-key keyboard
- User's Guide & "Easyview" stand
- MS/PC-DOS, OS/2, Unix, Xenix and Novell compatible.
- Choice of Vertical or Standard case
- 2 year warranty

Commercial leases start at \$141/mth.*

With Monitor & Video Board	Mono	EGA	VGA
65MB/28ms	\$4,199	\$4,499	\$4,599
120MB/28ms	\$4,599	\$4,899	\$4,999

We accept Visa, Mastercard (no surcharge), American Express, C.O.D. via certified check, qualified P.O.'s, money orders, wire transfers, and personal checks (allow 7 days to clear). Cash, check or wire transfer prepayments get 1% discount. Add 3% for shipping and handling (\$3 min.) or 4% for second day air on systems. In California add 7% sales tax. Call for shipping costs for Military addressed (APO/FPO) or if outside the continental United States. 45 day money back guarantee does not include monitors, accessories, return shipping and handling. Software, accessories, printers, monitors and shipping are not refundable. Replacement parts are cross-shipped via 2nd day air at Acma's expense with an approved RMA. Customers assume all responsibilities and costs for returning defective parts to Acma. We are not responsible for errors in typographic or photographic, and reserve the right to substitute equivalent, or better, parts. Prices and specifications are subject to change without notice, and all brand names are registered trademarks of their respective companies. Two year system warranty - 1st year parts and labor, 2nd year labor. Products not made by Acma are covered by the manufacturer's warranty. Commercial leasing is for qualified businesses only, and the amount listed is based on a 36 month, zero down, \$1 buy-out lease on base configurations. ** Free shipping of Video Combs is by UPS ground, and covers the monitor and video card when purchased separately from any other products.

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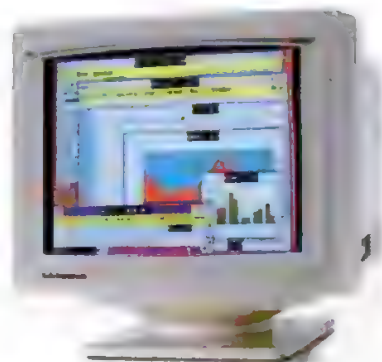
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SI Seiko Instruments Inc

First Looks

Mace Utilities, Version 1990: Emergency Room Pushes Aside Norton's Disk Doctor

HANDS ON
by Edward Mendelson

Wounded disks and traumatized data no longer need to worry about a shortage of medical care. *The Mace Utilities*, Version 1990, the latest upgrade of Fifth Generation Systems' \$149 utility package, includes an Emergency Room program with the most advanced treatment available for disk disasters. Emergency Room surpasses even the capabilities of the Disk Doctor of *The Norton Util-*

ities—Advanced Edition, until now the only program for automatic recovery from major injuries to disks and data.

Emergency Room, like the Disk Doctor, restores damage to boot sectors and partition tables that would normally make a disk unreadable. Both programs can partly unscramble damaged File Allocation Tables, although no program can completely repair major damage to a FAT. *Norton* sometimes takes hours to repair a FAT; *Mace* does the job in seconds.

Like Disk Doctor, Emergency Room is fully automatic, so you can use it even in a state of panic. But *Mace's* repairs, unlike *Norton's*, are reversible. If the automatic repair doesn't work—an inevitable risk with serious damage—you can restore the disk to its earlier state and attempt manual resuscitation using other utilities in the package.

Despite a new overall menu, *Mace* still looks more awkward than *Norton* and *PC Tools*. All three packages contain file finders, system statistics, disk formatters, testers, and defragmenters, plus programs to erase files beyond hope of recovery. *Mace* adds a moderately effective antivirus vaccine. It also adds a program that periodically copies the contents of DOS RAM to disk, so you can resume work after a power out-

age. This won't help if your application puts data into EMS memory.

Now that *Mace* is distributed by Fifth Generation Systems, which also markets *Fastback Plus*, it no longer includes a backup program. But you're probably better off without *Mace's* old backup clunker. *Mace* still comes with an unspectacular disk cache.

You won't buy *Mace* for fancy screens, but its Emergency Room makes it an indispensable supplement to—or substitute for—*Norton* or *PC Tools Deluxe*.

List Price: *The Mace Utilities*, Version 1990, \$149. **Requires:** 256K RAM, DOS 2.0 through 4.01. Fifth Generation Systems, 10049 N. Reiger Rd., Baton Rouge, LA 70809; (800) 873-4384, (504) 291-7221.

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Applause II: Reason to Switch from Harvard Graphics and Freelance?

HANDS ON
by Robin Rastin

Ashton-Tate's original *Draw Applause* drew little applause or market share. *Applause II*, a considerably overhauled version, handles charting, drawing, and on-screen presentations with a fluidity and ease of use not found in either *Harvard Graphics* or *Freelance Plus*—and it does all this in a mere 512K. But *Applause's* mere charting alternatives and limited selecting tools make you wonder whether it's worth switching from these old favorites.

Applause II is the first DOS-based presentation graphics program that makes intelligent use of the mouse without running under *Microsoft Windows*. The \$495 program uses a *Windows*-like interface, with lots of pull-down menus and pop-up dialog boxes. The inclusion of two Bitstream fonts is another welcome addition.

The program has three separate elements—Drawing, Charting, and Presenting—each with its own set of tools. As in

past versions, once you move a chart over to the Drawing component for embellishment, you lose any link to data—a serious shortcoming.

Charting components are not directly manipulable; you assign attributes from a parts list that changes depending on your chart type. This approach is only slightly more interactive than the design-by-forms technique used by *Harvard* and *Freelance*. Despite the addition of some data-import formats, warm links, a variety of new chart types, and chart templates, you'll find there are many things you can't do. For example, you can't have a line in a scatter plot or line markers on a line chart, and selecting 3-D bars will more often than not cause some of your variables to hide behind one another.

Color and special effects are the program's high points. *Applause's* distributed-shapes effect is a feature usually reserved for serious drawing programs. The selections of clip art, especially the backgrounds, are inspiring. Built-in color palettes

are resplendent, and clicking on any of the primary palette colors brings up a secondary list of shades. Graded backgrounds were never so easy to create. Graphic import from .GIF, .PCX, .TIF, .CGM, and more formats scores high marks, though *Applause* stumbles on .PCX or .TIF containing any bit depth.

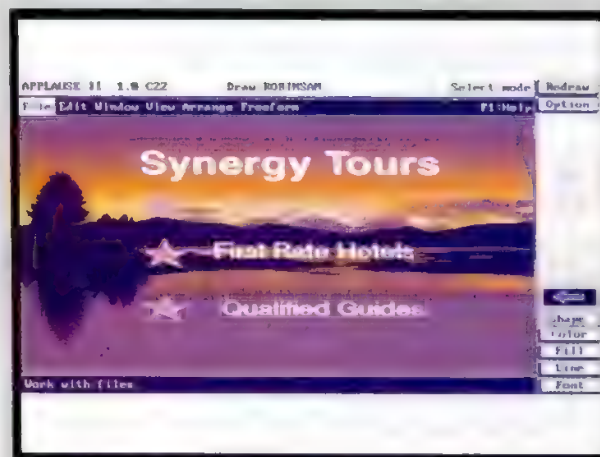
The presentation component is the least intuitive of the three. Using a step that builds batch files, *Applause II* creates a series of .GX2 files and lets you specify transitional effects.

There is no run-time version of the screen show.

A built-in link to its own service bureau, a slew of device drivers, and an easy installation help make this a full-bodied program. Overall, *Applause II* takes DOS-based presentation graphics one step further.

List Price: *Applause II*, \$495 (\$99.95 until April 1). **Requires:** 512K RAM, DOS 2.1 or later (DOS 3.3 required for 3.5-inch disks). Ashton-Tate, 200101 Hamilton Ave., Torrance, CA 90502; (213) 329-8000.

CIRCLE 430 ON READER SERVICE CARD



Easily created special effects like this graded background are among *Applause II's* high points.

First Looks

\$99.95 QuickGraph: Nine Screens, Instant Graphs

HANDS ON
by Henry Fersko-Weiss

Wading through countless menus and design options is the last thing you want to do when you need to produce a chart fast. But with Sumak Enterprises' \$99.95 *QuickGraph*, all you need do is click a few buttons, make a few selections in a dialog box, and your crisply drawn, colorful graph is rendered in no time.

QuickGraph has only nine different screens with which to become familiar. It uses *Microsoft Windows*-like command buttons, radio buttons, check boxes, list boxes, and palettes, all of which are so easy to control that you'll probably never have to consult the manual or on-line help after you've installed the program.

You can generate 32 types of graphs, including bar, pie, stacked area, jointed area, dual pie, stacked horizontal bar, and others. Graphs get their data from *QuickGraph* worksheets, imported *Lotus 1-2-3*, *dBASE*, or ASCII files, or the *WordPerfect* Clipboard. A dynamic linking feature lets you tether a graph to the original imported data file. If the data changes, the

graph will be updated the next time it's loaded—that is, if you want it to be.

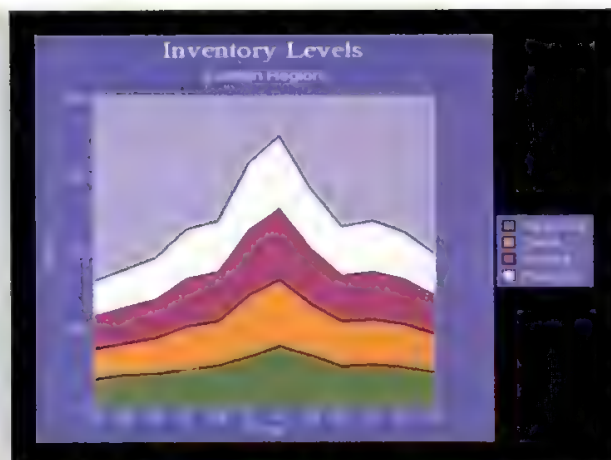
Once you've entered the data and selected a graph type, you can design the graph's look. Every parameter can be set with the click of a mouse. Times Roman and Helvetica in six different sizes are your choices for text, which along with background areas can be displayed in any of 15 colors. You can designate the line thickness, turn the grid on or off, situate the legend, and select colors or cross-

hatch patterns for graph elements. When you're done, you can preview the chart on-screen. The results are stunning even with simple graphs.

The program supports 100 printers, and printing graphs is as easy as designing them. You can print in portrait or landscape, size the output, control the margins, and set the resolution of the printer.

It would be hard to find a business graphics program that combines as much elegance and simplicity as *QuickGraph* does. For \$99.95, it's impossible to go wrong with this package. ■
List Price: *QuickGraph*, \$99.95. **Requires:** 512K RAM, hard disk, DOS 2.0 or later. Sumak Enterprises, 39 Dawson Dr., Sudbury, MA 01776; (508) 443-0205.

CIRCLE 486 ON READER SERVICE CARD



QuickGraph controls all elements in a graph. As this area graph shows, you can use five text sizes in one screen.

TSR Management for Systems Supporting EMS 4.0

HANDS ON
by Ray Duncan

It's the rare DOS user who doesn't have the names of at least two or three TSRs in his or her AUTOEXEC.BAT file. It's also the rare DOS user whose system isn't suffering from RAM *cram*—when TSRs compete for memory with the applications they are supposed to enhance.

BLOC Publishing Corp.'s *PopDrop Plus*, a new wrinkle

on the TSR-management concept, can exploit expanded memory to cache TSRs when they are not in use, instead of discarding them from memory altogether or swapping them out to a disk file.

The most important components of the \$99.95 *PopDrop Plus* are two utilities, *POPDROP.COM* and *POPLOAD.COM*, and two device drivers, *POPDROP.SYS* and *POPLOAD.SYS*. *POPDROP.COM* is a sort of snazzy descendant of

two public domain programs, *Mark and Release*; if you run *POPDROP.COM* before and after you load a TSR, it figures out which interrupt vectors, memory, and other system resources were grabbed by the TSR so that it can restore those resources to their original state if you decide to dump the TSR from memory. *POPLOAD.SYS* is an optional device driver that monitors EMS memory usage by TSRs on behalf of *POPDROP.COM*; you don't need to install *POPLOAD.SYS* unless you are going to be using *POPDROP.COM* to unload TSRs that allocate expanded memory

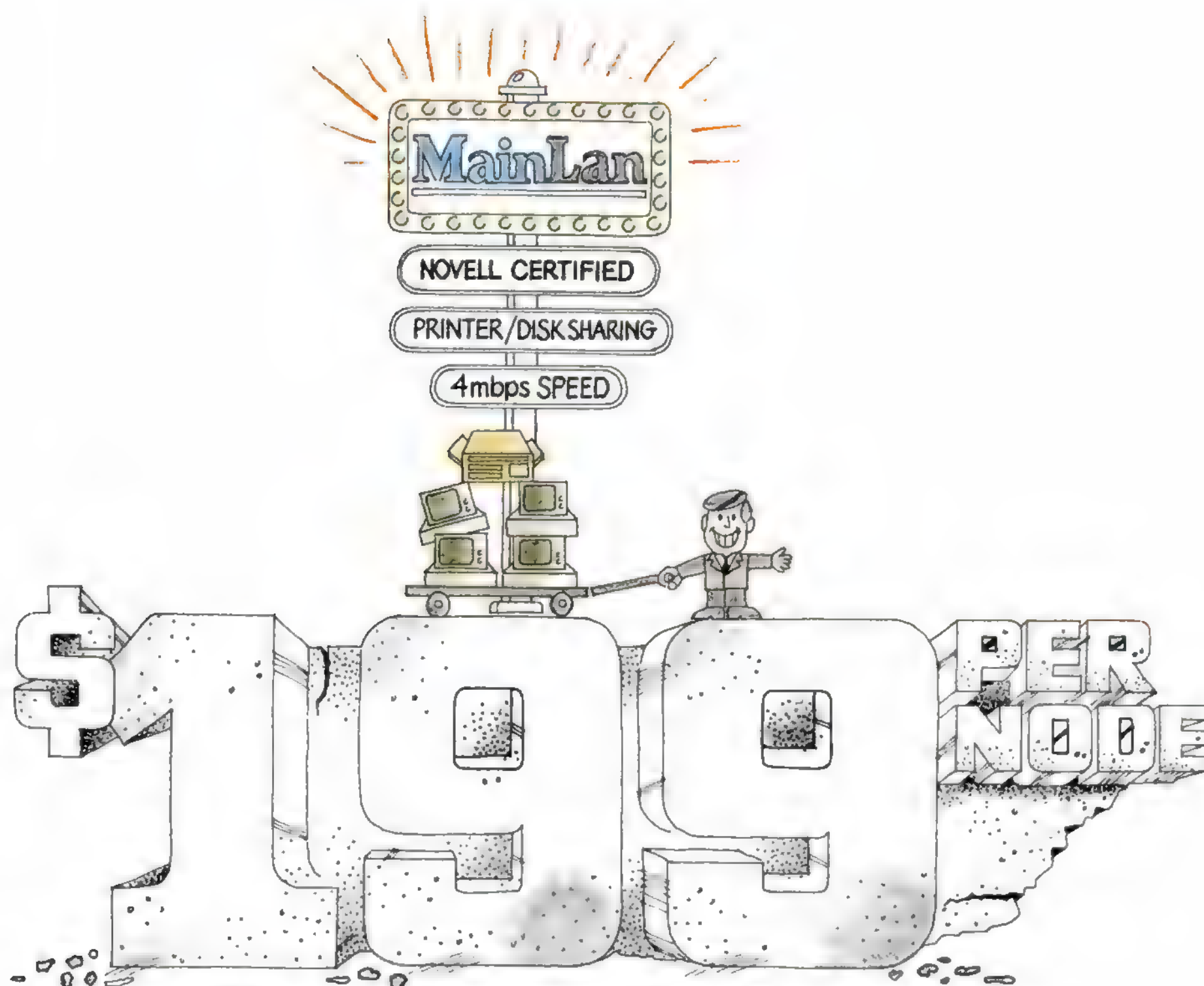
for their own purposes.

POPLOAD.SYS and *POPLOAD.COM* hold the program's more-exceptional features. *POPLOAD.SYS* is a 1K device driver that you load with a *DEVICE=* statement in your *CONFIG.SYS* file, immediately after the *DEVICE=* line that loads your EMS 4.0 memory manager. It monitors EMS usage and hotkeys on behalf of *POPLOAD.COM*. You then run *POPLOAD.COM*, either interactively or in your *AUTOEXEC.BAT* file, supplying it with the name of a file that contains a list of TSR programs and their hotkeys. When you press one of the hotkeys in the list for the first time, *POPLOAD* fetches the TSR from disk and installs it in EMS memory. All subsequent presses of the hotkey cause *POPLOAD* to map the EMS pages containing the TSR into main memory and activate the TSR. *POPLOAD* also has its own pop-up control panel that allows you to view EMS memory usage and load or unload TSRs by name.

PopDrop Plus is clearly documented and easy to use, but you should take note of its hardware requirements and other limitations before deciding to purchase it. For one, *PopDrop Plus* demands EMS 4.0-compatible boards and drivers. Furthermore, its caching of TSRs in EMS memory is not compatible with TSRs that use EMS memory themselves, service hardware interrupts, or are activated in ways not visible to the *POPLOAD* TSR manager. TSRs in this category (such as network drivers) are often the ones that you would like to get out of the way. But if you use lots of classic TSRs like *SideKick*, *SuperKey*, and *XDIR*, *PopDrop Plus* may be just the remedy for those nasty "out of memory" error messages. ■

List Price: *PopDrop Plus*, Version 3.1, \$99.95. **Requires:** DOS 2.1 or later, EMS 4.0-compatible expanded memory board and driver. *POPDROP* requires 1K RAM, *POPLOAD* requires 30K RAM. BLOC Publishing Corp., 800 S.W. 37th Ave., #765, Miami, FL 33134; (305) 445-0903.

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First Looks

Grammar Checkers Improve, But Won't Replace Your English Teacher

HANDS ON
by Jonathan Meakin

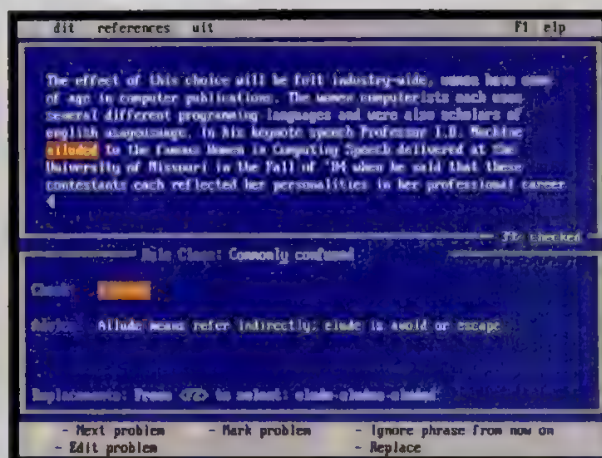
Since written expression has always been a such a chore, grammar- and style-checking software for the PC seems like a natural tool for our electronic desktops. Packages like Reference Software's *Grammatik* and RightSoft's *Right Writer* should save us from constantly minding our phrases and clauses, just as spelling checkers shield us from the drudgery of memorizing all those rules (and exceptions) of spelling.

Well, yes and no. *Right Writer*, Version 3.1, and *Grammatik IV* show continuing improvement in the category. Aside from more effectively evaluating written English,

You specified a file to be analyzed, and the program went to work. Depending on the software, you were either left with a marked-up file to examine and edit with your word processor or you were given the opportunity to make changes on the fly, using a built-in editor.

Last year saw a breakthrough in interface design when *Perfect Grammar* was offered as a feature of Lifetree's *Volkswriter 4* word processor. Grammar-checking became as simple as tapping a hotkey from within the word processor.

Reference Software sees the value in this tight integration. *Grammatik* can now be called up from within *WordPerfect 5.0* (a patch is available for 5.1), *Microsoft Word 5.0*, *WordStar*



Grammatik IV spots problems and gives you the choice of making corrections or marking them for later editing.

and then analyzing the document you were working on. When you finish with *Grammatik*, the program stores the edited file, reloads your word processor, and returns you to the file you were working on. Unfortunately, this context-switching process makes *Grammatik* seem not quite as tightly integrated as *Perfect Grammar* is with *Volkswriter 4*.

Grammatik still offers its native interface for use when the program is run as a standalone application. The word processor-like analysis screen highlights problems on the fly, and gives you the choice of making corrections or marking them for later editing.

Right Writer has also been enhanced to work more closely with word processors. As of this writing, Version 3.1 can only be directly called from within *WordPerfect*. The process is similar to *Grammatik*'s context-switching approach. RightSoft promises a much longer list of directly supported word processors in an upcoming revision. *Right Writer* still supports a host of word processor formats in standalone mode.

Right Writer and *Grammatik* base their analyses on rule-based artificial intelligence systems. *Right Writer* 3.1 boasts more than 500 new rules, and *Grammatik*'s rule set has also been enhanced. The results are encouraging.

Both *Right Writer* and

Grammatik flagged passive-voice constructions that I tried to slip by them. *Grammatik* also rooted out situations that called for the subjunctive mood, while *Right Writer* sailed right over these. As with the previous versions of both packages, run-on sentences were ignored, whether or not they were joined by a comma.

Unfortunately, we have not yet reached the point where grammar checkers do their job as efficiently as spelling checkers do theirs. These packages are useful, however, for people who don't have as much time as they would like to spend on their writing. *Grammatik* or *Right Writer* will catch many faults and serve as a useful tool when used in conjunction with a critical human mind. ■

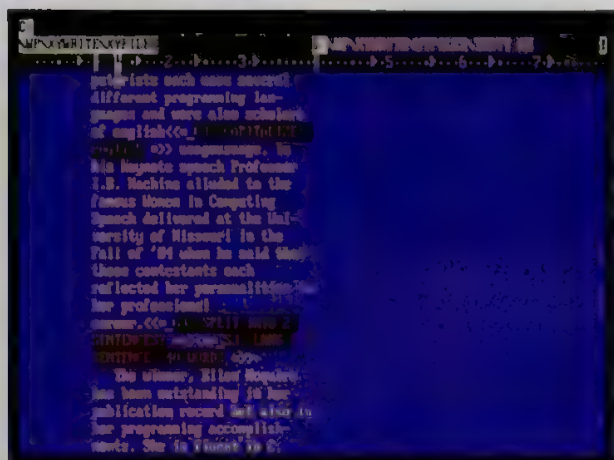
List Price: *Grammatik IV*, \$99. Upgrade for *Grammatik III* users, \$29. **Requires:** 512K RAM, hard disk, DOS 2.0 or later. Reference Software International, 330 Townsend St., #123, San Francisco, CA 94017; (415) 541-0222.

CIRCLE 446 ON READER SERVICE CARD

List Price: *Right Writer*, Version 3.1, \$95. Upgrade for Version 3.0 users, \$25 plus \$6.50 shipping. Patch for direct access to *WordPerfect 5.1*, \$10.

Requires: 384K RAM, two disk drives, DOS 2.0 or later. RightSoft Inc., 4545 Samuel St., Sarasota, FL 34233; (813) 923-0233.

CIRCLE 445 ON READER SERVICE CARD



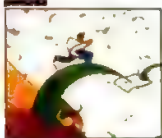
Right Writer 3.1 bases its analyses on an artificial intelligence system with more than 500 new rules.

these latest versions offer much-improved user interfaces, which can make using them almost as easy as spell-checking a document. But these programs won't replace human editing; they still miss some obvious, egregious writing faults.

Originally, grammar checkers ran as separate applications.

5.5, and Software Publishing's *Professional Write 2.1*, among others. I tried the program with *WordPerfect 5.0* and *XyWrite*, and it worked as intended in both cases.

Grammatik goes through some serious gyrations in the process of storing your current file, closing your word proces-



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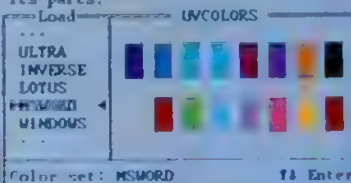
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First Looks

Multitack Enhances Windows Clipboard

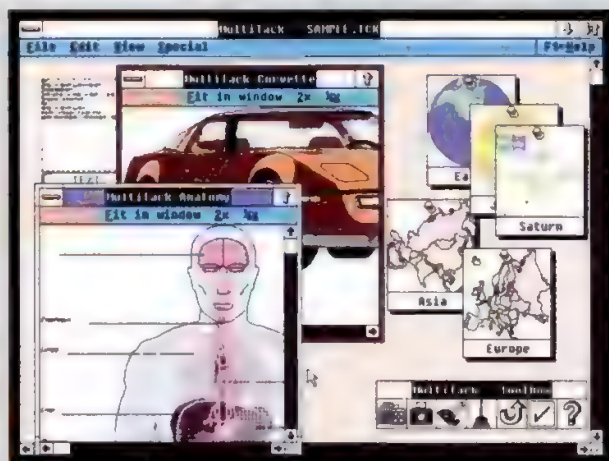
HANDS ON
by Barry Simo

One of the advantages of graphical user interfaces like *Microsoft Windows* and the OS/2 Presentation Manager and some third-party utilities is the way they let you glue programs together. Publishing Technologies, the maker of *CBM Office* and *Batchworks*, has focussed on providing such utilities for *Windows*. Its newest program, *Multitack*, a \$149.95 *Windows* Clipboard enhancer, is brilliant in design but suffers from some flaws in implementation.

Multitack lets you save files of related clip art and text, will automatically save Clipboard contents when *Windows* erases them, provides a screen capture for *Windows* as well as limited conversion facilities between graphical formats.

The main *Multitack* window uses the metaphor of a tack board, on which you keep Clipboard contents in miniature form. Double clicking on a tack enlarges it into a small window, which can be further expanded. You can obtain tacks from the Clipboard either by automatically saving everything copied to the Clipboard or manually shift-dragging Clipboard contents. You can also import 12 file types: five bitmapped (including .TIF and .PCX), four vector graphics, and three text formats. You can export into some formats, but not in .TIF or .PCX.

The very graphical *Multitack* environment is a pleasure to use. Because you can overlap tacks, you can place a lot of information on a single screen. The nicest touch is that you can shift-drag a tack from the *Multitack* window to an application and have *Multitack* paste that



Because *Multitack* lets you overlap tacks, you can place a lot of information on a single screen.

tack into the application through the Clipboard. A visual toolbox of icons is so straightforward that you'll hardly need to access the menus.

Unfortunately, the program has some limitations. Some major file formats, like .EPS, .CGM, and Rich Text, are not supported. And some of the supported formats aren't fully supported. Try importing a compressed .TIF or certain .PCX or Micrografx's *Graph* files, and you'll find that *Multitack*

can't save them as tacks. And tacks save only one format, though the Clipboard supports more. But if you can live with these limitations, *Multitack* is quite a useful tool. ■

List Price: *Multitack*, Version 1.0, \$149.95. Publishing Technologies Inc., 7719 Wood Hollow Dr., #260, Austin, TX 78731; (800) 782-8324.

Requires: 640K RAM, *Microsoft Windows* 2.03 or later, mouse, DOS 3.0 or later.

CIRCLE 442 ON READER SERVICE CARD

John C. Dvorak Tells All About Telecomm

BOOK REVIEW
by Catherine D. Miller

We've come to expect *PC Magazine*'s famed columnist and industry pundit, John C. Dvorak, to do things in a big way. At over 1,100 pages plus two disks, *Dvorak's Guide to PC Telecommunications* leaves no stone unturned in providing information about this complex topic. Even the book's dedication—for all mankind—is expansive. From modem basics to practical guidance for using on-line services to complex technological issues, this book encompasses all aspects of using your PC's modem to communicate with the rest of the world.

This comprehensive book is not solely the work of the two authors, John C. Dvorak and

Nick Anis. Five pages of acknowledgements credit the many experts who contributed their knowledge and practical experience to this undertaking. Although as many as ten people were responsible for the information in an individual chapter, the book doesn't read like a jumble of voices; Dvorak's style is apparent throughout.

Divided into four parts, the book provides information about products that fulfill various needs. READ.ME sections are interspersed throughout the text, drawing attention to interesting adjuncts to the topics under discussion. Beginning with "A Layman's View," you'll learn how to use a modem, communications programs, e-mail, BBSs, and on-line services. Chapters devoted to connecting

to Macs and mainframes and communicating internationally are very informative.

Part two covers the more technical aspects of telecomputing. Chapters are devoted to demystifying modem functions and file transfer protocols. Integrated Service Digital Network and other technologies of the future are also discussed here.

The third part of the book documents the shareware included with the book. I was most impressed with the quality of the software included on the dual disks accompanying the book. An on-line telecommunications and modem tutor, and several shareware programs are unified by an attractive DOS shell. The tutorial consists of a series of screens, including descriptive articles and demos of BBS services, so beginners can become familiar with how they work and what they look like before they actually dial up and log on.

The last part of the book is devoted to the appendices, which include reading, shareware, and freeware recommendations. The glossary defines just about any ambiguous technical term used in the course of describing a procedure or technology. Other appendices include regional access numbers for Telenet, Tymnet, and CompuServe, and the numbers for over 2,000 bulletin boards. Bulletin board numbers change often, so some of this information could be outdated within months of the book's publication. I found the number for *PC Magazine*'s now-defunct on-line service, PC-IRS, which was replaced by PC-MagNet on CompuServe several months ago.

Whether you want to figure out how to make better use of your modem, or you're looking for a good telecommunications reference, *Dvorak's Guide to PC Telecommunications* is the definitive text. ■

List Price: *Dvorak's Guide to PC Telecommunications*, by John C. Dvorak and Nick Anis, \$49.95. ISBN: 0-07-881551-7. Osborne McGraw-Hill, 2600 Tenth St., Berkeley, CA 94710; (800) 227-0900.

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*PC Magazine, On why the ZEOS®
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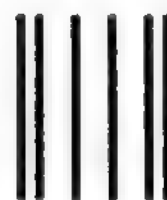
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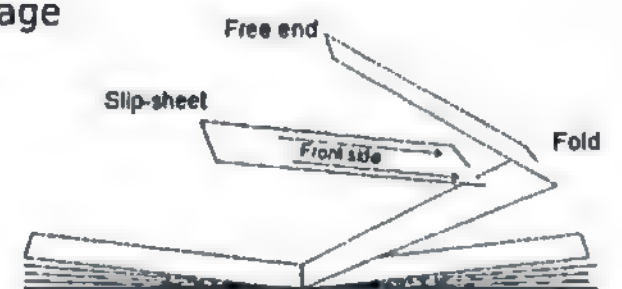
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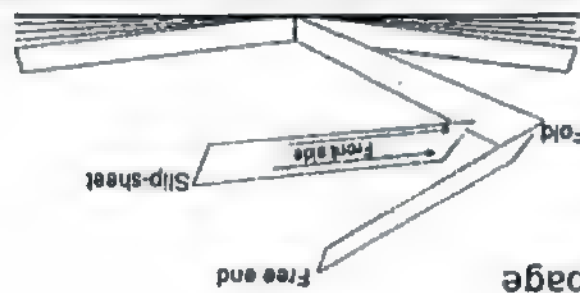




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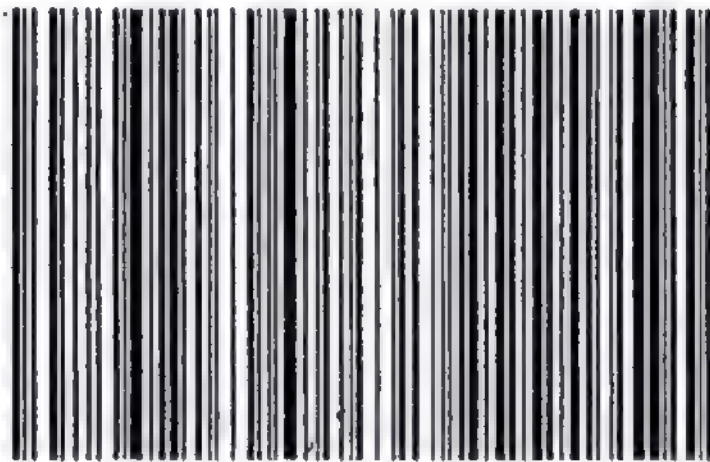


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Back

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10 Good Reasons To Buy From ZEOS®

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As *PC Magazine* said "Price is always a consideration. So are benchmark test results. But both factors can be deceiving, which is why we consider them in the context of other aspects that will make the difference months and years down the road."

These are the attributes which *PC Magazine* used in awarding ZEOS the coveted Editor's Choice, not once but three times. And "Overall Excellence" are the very words *PC Magazine* used in describing ZEOS systems comparing them to all others.

Reason #2

Dazzling Performance.

In one recent review, *PC Magazine* awarded ZEOS Editors Choice. "The ZEOS '386 blows away every other computer... a smart choice" is what they said. And in another review, *Government Computer News* said the ZEOS 33MHz '386 is "arguably the fastest MS-DOS and OS/2 micro in the world"

Dazzling Performance is built into every ZEOS system. It's a key component of ZEOS Overall Excellence.

Reason #3

Exceptional Quality.

PC Resource Magazine put it this way, "ZEOS... provides quality comparable with IBM or Compaq and does so for about 70% of the price." ZEOS uses only the very best components. And every system is fully tested and burned-in right in our own labs.

Reason #4

Value.

InfoWorld says, "We find the ZEOS '386 an excellent value. Speed: Excellent. Compatibility: Excellent.



Value: Excellent."

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Reason #6

24 Hour Toll Free Technical and Sales Support.

At ZEOS, the customer is #1. That's why we're open around the clock. For your convenience. If you buy a product from us we feel we should be there to help, 24 Hours a day. Our Help Lines are Toll Free too. Because you shouldn't have to pay for the call.

Reason #7

Experience.

Almost unique in the mail order computer industry, ZEOS maintains its own chip level Research and Development staff. In addition to Systems Manufacturing, we also operate our own Board Level Manufacturing facility.

ZEOS has been involved in Research and Development since our incorporation back in 1981. Our strong and experienced Research, Manufacturing and Technical Staff translates into superior factory direct computer systems for you.

Reason #8

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In magazine after magazine and review after review ZEOS systems are sighted for Overall Excellence, for Excellent Value, as the Right Choice and so on. All of this is flattering but the most important thing is this: What do our customers think? Frankly, they love us. The systems and the support. That means more to us than anything.

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First Looks

Communications Program for DOS and OS/2 Uses REXX for Script Development

HANDSON
by Salvatore P. Ricciardi

What do you want in a communications script language? Ease of learning and ease of use? The ability to do almost anything a real programming language can do? Or do you just want to use the same script language you're already using with your editor and with DOS?

If you're using Personal REXX, Mansfield Software's PC version of the REXX programming language, you're in luck. Quercus Systems' new communications program for DOS and OS/2, *REXXterm*, uses Mansfield's REXX as its script language, and it packs such powerful features as a built-in Xedit-like text editor and the ability to recall, edit, and resend text previously sent to a remote computer.

Developed by IBM for its mainframes, REXX is IBM's

SAA-standard command language. To further ensure REXX's future importance, IBM is including a version of it with OS/2 1.2 Extended Edition. Mansfield's implementation, Personal REXX, serves as an advanced batch language for DOS or OS/2, and as an advanced macro facility for the vendor's *Kedit* text editor (see First Looks, *PC Magazine*, October 31, 1988, p. 54), making it a good choice for *REXXterm*'s communications script language.

Beyond its being a personal programming tool, REXX is a complete language supporting variables and arrays, looping and conditional control structures, file and device I/O, and a library of built-in functions—all of which nicely round out *REXXterm*'s own impressive list of features. Among these is a built-in ASCII file editor, which lets you edit multiple

files simultaneously. You can use the editor or a built-in file browser during file transfers.

REXXterm's command history lets you edit any of the last 20 lines of text sent to a remote computer and then resend it—a real timesaver if you often retype the same text.

The program lets you capture a communications session to memory, disk, or the printer. When you capture to memory, the capture buffer can be as large as available memory, including EMS. You can scroll through the capture buffer, edit it using the built-in editor, search it for strings, or copy portions of it to other files or to the printer. Accessing the capture buffer is as easy as hitting the PgUp key, which places you in the built-in editor. You can access the capture buffer at any time during a session.

When you choose to save captured information to disk, you can have *REXXterm* generate a unique filename for you. For example, specifying a pattern like FILE????.DOC would generate FILE0001.DOC, if that name didn't already exist in the current or specified directory. If it did exist, FILE-0002.DOC would be used. When used inside of a REXX script, for example, you could have *REXXterm* generate a unique filename for saving the transcript of each session.

REXXterm is extremely reconfigurable, allowing you to create and automatically load single-key macros. You can assign commands to just about any key, and you can change all of the defaults. For example, if you'd rather have the Up Arrow key bring you into the capture buffer instead of the PgUp key, that's no problem. Using either the menu system or REXX scripts, you can customize the environment to your liking. In addition, you can assign defaults for things like what file transfer protocol to use or where to place downloaded files. Even entire REXX scripts can be tied to a keystroke.

The program supports several file-transfer protocols, among them Xmodem, Xmodem-1K, Ymodem batch, Zmodem, Kermit, and Compu-

FACT FILE

REXXterm, Version 2.2

Quercus Systems, P.O. Box 2157, Saratoga, CA 95070; (408) 257-3697.

List Price: DOS version, \$75; OS/2 version, \$100.

Requires: DOS version: 512K RAM, DOS 2.0 or later; DOS version of Personal REXX 2.0 required for scripting. OS/2 version: 250K RAM, OS/2 1.0 or later; OS/2 version of Personal REXX 2.0 required for scripting.

In Short: A powerful communications package that shines when used with Personal REXX. Supports multiple dialing directories and command recall; includes a built-in text editor and browser.

CIRCLE 431 ON READER SERVICE CARD

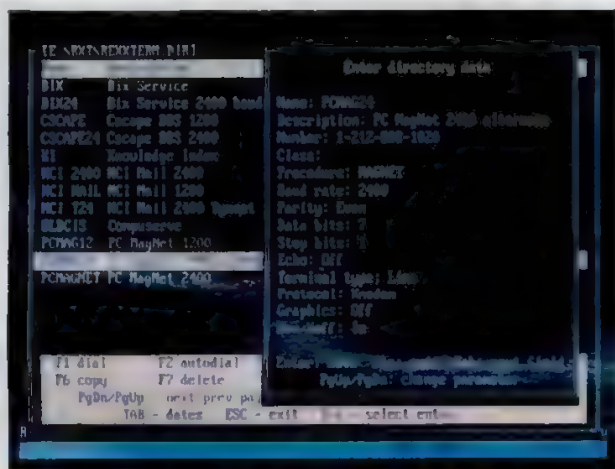
Serve-B. In addition, it offers several pacing options for ASCII file uploads.

REXXterm supports multiple dialing directories, each of which can hold any number of entries. A REXX procedure can be linked to each entry and automatically invoked upon connection. You can select a list of numbers to be called automatically. *REXXterm* records the date and time of the last connection, and it maintains a count of the total number of calls for each entry.

A built-in file manager lists files from any directory in a window, and it lets you invoke certain *REXXterm* functions against any file in the list using a point-and-shoot interface—a handy feature if you can't remember a filename or want to check on a file's existence.

All major functions in *REXXterm* are available either through menus, a command line, or user-definable keystrokes. Internally, *REXXterm* is entirely command-driven, so you can use the interface with which you're most comfortable. Commands issued through the command line are the same ones you would use from within REXX scripts. A command-line history feature lets you recall and reissue past commands.

REXXterm is an impressive product. When combined with Personal REXX, it provides unprecedented programmability. ■



REXXterm supports multiple dialing directories, each of which can hold any number of entries. It records the date and time of the last connection, and it maintains a count of the number of calls for each entry.

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- 2 SERIAL PORTS, 1 PARALLEL PORT AND 1 GAME PORT
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66MB RLL/28MS	550	700	930	1,055	1,180
71MB MFM/28MS	770	920	1,150	1,275	1,400
100MB IDE/25MS	850	1,000	1,230	1,355	1,480
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330MB ESDI/18MS	2,100	2,250	2,480	2,605	2,730

*Prices listed are available with complete system purchase only.

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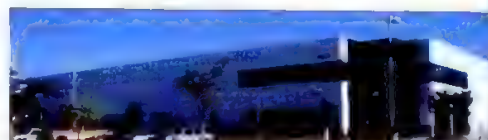
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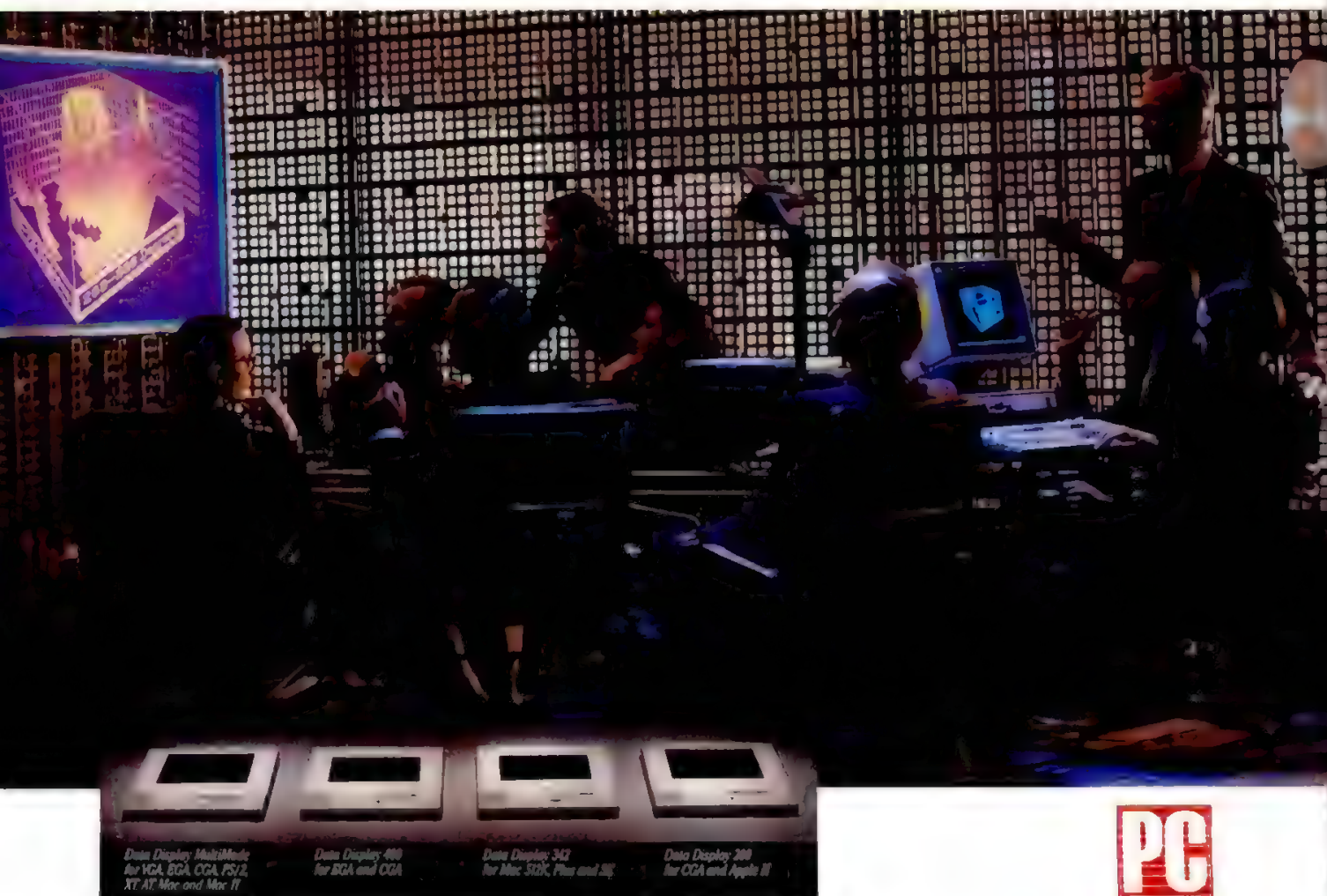
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by
Alan Cohen

New & Improved

News of Announced Products and Upgrades

NEW

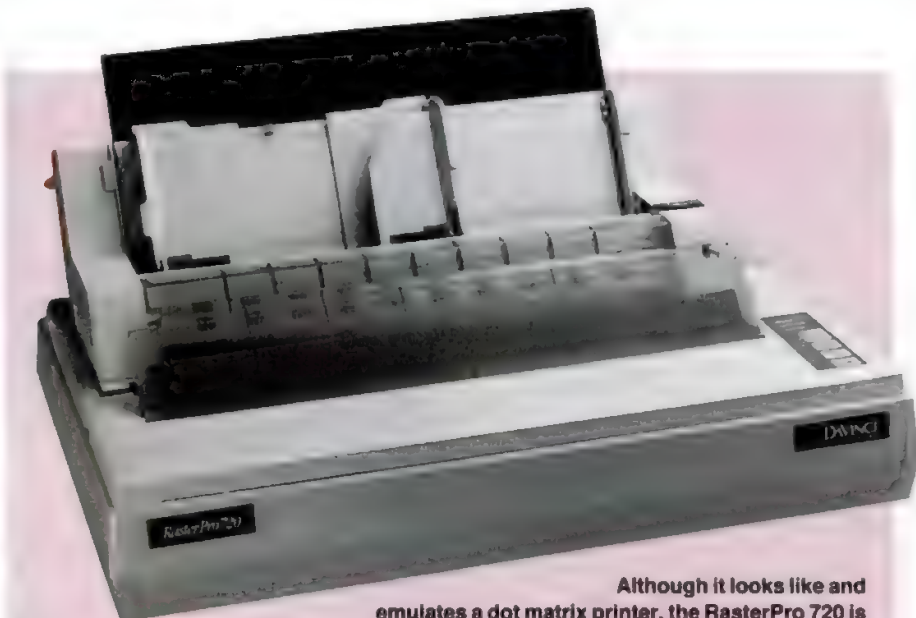
Da Vinci Graphics' RasterPro 720 Plots Without Pens

With its new color graphics plotter, **Da Vinci Graphics** has managed to overcome a troublesome and frustrating problem inherent in more-conventional plotters: malfunctioning pens. It's done this by completely eliminating pens from its \$3,495 unit, the RasterPro 720.

Capable of producing 8.5- by 11-inch and 11- by 17-inch plots, the RasterPro 720 uses a proprietary image-processing technology to convert vector-based plotting specifications into an optimized raster format. Instead of pens, the plotter uses a 24-pin dot matrix printhead. The unit's increased throughput and the absence of sliding pens result in quicker plots. According to the company, the RasterPro 720 is up to 10 times faster than conventional pen plotters in producing high-resolution output.

The unit features an addressable graphics resolution of 720 dots per inch, four user-selectable line widths—from 0.2 mm to 1.3 mm—and a palette of 15 colors.

Compatible with the Hewlett-Packard



Although it looks like and emulates a dot matrix printer, the RasterPro 720 is actually a penless color graphics plotter.

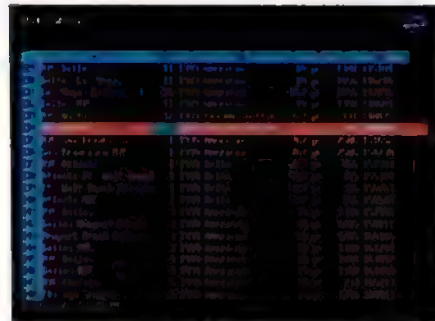
Graphics Language, the RasterPro 720 can also function as a conventional dot matrix printer, operating in Epson emulation mode. **List Price:** RasterPro 720, \$3,495. Da Vinci Graphics Inc., 870 Hermosa Dr., Sunnyvale, CA 94086; (408) 737-8800.

CIRCLE 436 ON READER SERVICE CARD

NEW

REDline Adds Some Weight to Your Cursor

Thanks to a new software utility from Dyna-Corp, PC users can spend more time concentrating on their work and less time hunting for their cursor.



When used within 1-2-3, REDline lets you quickly spot a hard-to-find cell.

REDline, a \$39.95 program that works with text-oriented applications such as spreadsheets, word processors, and databases, provides users with a full-screen-width

CONTINUES ON PAGE 54

HOT PROSPECT

SPELLCODE CHECKS PROGRAMS, DATABASE FILES, SPREADSHEETS

For every spelling checker-equipped word processor or desktop publisher user out there, there's at least one spreadsheet user desperately trying to remember the "i before e" rule for his "Receivables" column.

Well, **Geller Software Laboratories** is a company that feels it's every PC user's right to spell words correctly. Geller's new release, *SpellCode*, is a spell-checking package aimed specifically at programmers, database, and spreadsheet users.

SpellCode can correct spelling in programming code in one of two ways: it can either check only the text displayed to users or check the entire contents of the program file. The utility is supplied with a dictionary of computer terms as well as a standard English language dictionary.

Furthermore, *SpellCode*, which employs a graphical, windowing interface, can check the contents of character and memo fields in .DBF database files and 1-2-3 worksheets. The package also recognizes keywords used in dBASE languages, DOS batch files, C, Pascal, BASIC, R-base, and Paradox.

List Price: *SpellCode*, \$99.95. **Requires:** 256K RAM, DOS 2.0 or later. Hard disk recommended. Geller Software Laboratories Inc., 35 Stephen St., Montclair, NJ 07042; (201) 746-8467.

CIRCLE 432 ON READER SERVICE CARD

New & Improved

REDline

CONTINUED FROM PAGE 53

color-selectable cursor line. The utility may be especially valuable for the laptop user, who often has enough trouble just reading his display.

When used in conjunction with a spreadsheet program, the current cell is highlighted within the cursor line. A hotkey toggles *REDline* on and off.

List Price: *REDline*, \$39.95. **Requires:** 14K RAM, DOS 2.0 or later. DynaCorp Inc., 4828 Loop Central Dr., #520, Houston, TX 77081; (800) 777-8320; (713) 664-1492.

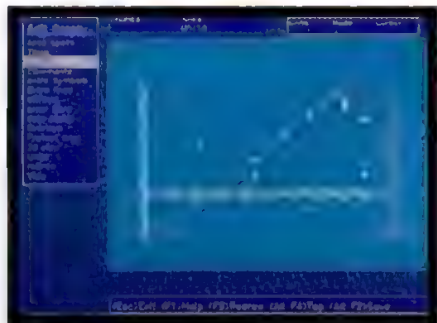
CIRCLE 433 ON READER SERVICE CARD

NEW

Axum Creates High-Resolution Technical Graphs

Axum, a \$495 graphics and data-analysis package from TriMetrix, brings the ease of use of business graphics software to the more technical world of the engineer and the scientist.

The package, which uses a windowing and menuing environment, offers an extensive selection of 2-D and 3-D scientific graph



Axum provides a graphics editor for users who wish to customize and annotate their plots and graphs.

types, including logarithmic axes, polar coordinates, 3-D mesh-and-line plots, regular and irregular contour plots, and error-bar charts. Advanced text features such as angling, super- and subscripting, and scientific and Russian fonts, are also included.

Axum users have access to nine different line types and an assortment of page layout features. Users can resize and overlay multiple graphs on a page, insert and rotate objects, and control page size and the axes' size.

A data editor allows for the importing, entering, editing, transformation, generation, and analysis of data. Data sets are unlimited

Publisher's Powerpak for Microsoft Windows—The newest edition of Atech Software's *Publisher's Powerpak* supports *Microsoft Windows*. The program, a software-implemented PostScript solution for dot matrix, ink jet, and non-PostScript laser printers scales fonts on the fly; in *Windows*, each typeface is scalable from 4 to 127 points. Thirty typefaces are included, all of which can be printed in either portrait or landscape mode. Add-on Atech typeface packages can be purchased for \$29.95 each (Monotype typefaces are also available for \$79.95 per package). *Publisher's Powerpak for Microsoft Windows* retails for \$199.95. Atech Software, Carlsbad, Calif.; (619) 438-6883.



The latest release of *Publisher's Powerpak* allows users to create personal font sets for use with *Windows* applications.

PrintCache, Version 2.2—LaserTools Corp. has upgraded its *LaserTORQ* print-buffering utility and christened the enhanced release with a new name. *PrintCache*, Version 2.2, continues to support laser printers, including the HP LaserJet IIP, and adds drivers for

CONTINUES ON PAGE 56

in size, and multiple data sets can be analyzed, graphed, and viewed simultaneously. An interactive graphics editor is also provided to modify comments, arrows, and axes.

In all, over 100 functions and operators are available for manipulating and transforming data, either through menu selections or directly through the package's built-in programming language.

Furthermore, *Axum* performs curve fitting and data smoothing. Data can be imported from *Lotus 1-2-3*, *dBASE*, and ASCII files, while graphics can be exported in Hewlett-Packard HPGL, *Lotus .PIC*, *PostScript*, and *GEM* formats.

List Price: *Axum*, \$495. **Requires:** 512K RAM, hard disk, graphics adapter, DOS 2.0 or later. Math coprocessor recommended. TriMetrix Inc., 444 N.E. Ravenna Blvd., #210, Seattle, WA 98115; (800) 548-5653, (206) 527-1801.

CIRCLE 434 ON READER SERVICE CARD

NEW

Outrider Provides Up-to-Date Details On Network Status

Designed for use with Novell's *NetWare*, *Outrider*, from Daystrom Data Products, monitors and records network activity.

The package, which retails for \$89.95, keeps track of current and average CPU utili-

zation, free and maximum directory entries, and free and maximum disk space. *Outrider's* Dense Pack Monitor Screen displays the status of up to four file servers with up to 5 volumes each, using colored indicators. Up to six user-defined sensors can be created to monitor various aspects of the network.

List Price: *Outrider*, \$89.95. **Requires:** Novell's *NetWare*, Version 2.0A or later. Daystrom Data Products, 15 Sunrise Hill Rd., Fishkill, NY 12524; (914) 896-7378.

CIRCLE 452 ON READER SERVICE CARD

NEW

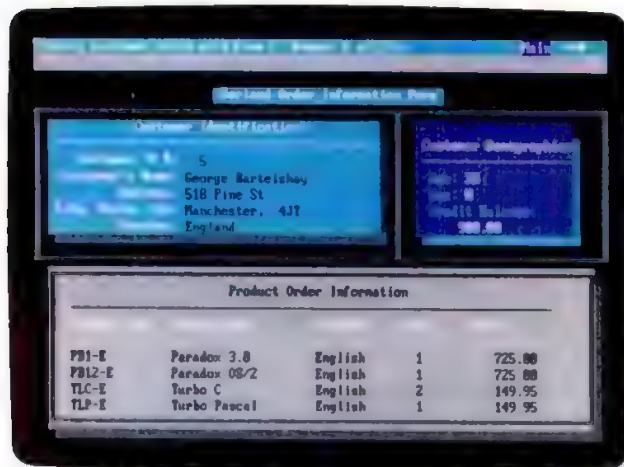
HyperEdit Simplifies Programming Code Searches

HyperEdit, a new programming editor from Speedywrite Software, is designed to greatly simplify searching tasks within a programming project. The package works with BASIC, C, COBOL, *dBASE IV*, FORTRAN, assembler, Modula-2, and Pascal languages. According to the company, *HyperEdit* can be configured to work with any other language as well.

The package's LookUp feature can, when triggered by a single keystroke, find the definition or declaration of any function, data type, or variable, even across files and in multiple-language projects. Lists of variable, type, and

CONTINUES ON PAGE 59

Power without pain.



Multitable form dynamically displaying information from three related tables.

You don't have to be a programmer to have easy access to our highly sophisticated, powerful relational database, Paradox® 3.0.

Paradox 3.0 is all-powerful and never painful because it makes all the complex inside moves, you don't. While it does the complex for you, the complexity is hidden beneath clear, natural, even intuitive pathways and patterns that make life easy for you.

With Paradox 3.0, there are no Unclears, no Unknowns. You don't need an army of in-house technical support people. And best of all, you *don't have to be a programmer* to be a pro with Paradox. It's all gain, no pain.

✓ "Query-by-Example" for example

Use this checkmark and you're using QBE.

It's that easy. Let's say you need to know in a hurry which of your Los Angeles customers bought more than 5 pairs of white shoes. First ✓ the customer field, then type "LA," "white," and ">5," and you're done. Paradox gives you the right answer, right now. And how much programming to do all that? Zero.

If your database experience so far is limited to the flat-file type rather than relational, or even if a

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CODE: MX20

spreadsheet is the only program you've used before, Paradox gets you up and running immediately with just a ✓.

Record-locking and Auto-Refresh make the network safely network

Paradox has become the leading networker because it handles multiple users intelligently. If someone in your group or network has accessed a record, automatic record-locking keeps everyone else from changing it.

That way, two or more people can't change the same data at the same time. (As a bonus, Paradox also tells you *who* is using a record at a particular instant.)

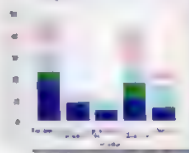
Once the record has been changed by someone in the network, *Auto-Refresh* kicks in *automatically* and updates everything. Everyone in the network is looking at up-to-the-minute information.

Paradox, for the looks of things

Presentation-quality graphics are another Paradox distinction. They give you and your work the professional look.

Paradox instantly turns your tables into graphs with *one* keystroke—and in multiuser environments, with a few keystrokes your graph can show up-to-the-minute changes. Not only does everyone get the picture, they get an accurate picture.

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Address - Shipping Labels			
5160	1" x 2 5/8"	30	100
5161	1" x 4"	20	100
5162	1 1/3" x 4"	14	100
5163	2" x 4"	10	100
5164	3 1/3" x 4"	6	100
5165	8 1/2" x 11"	1	100
5267	1/2" x 1 3/4"	80	25

Laser Diskette Labels

5196	2 3/4" x 2 3/4"	9	70
for 3 1/2" diskettes			
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Also available are
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New & Improved

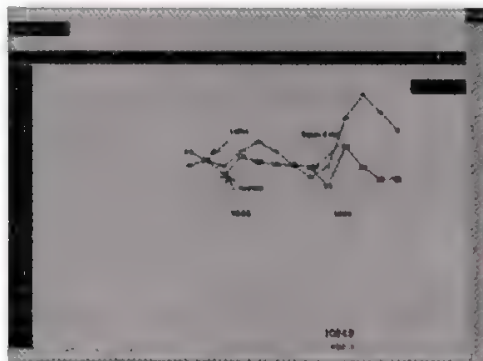
IMPROVED

CONTINUED FROM PAGE 54

plotters and dot matrix and ink jet printers. New features to the program include a reduced RAM requirement—now as little as 5K—support for printer-sharing devices, support for buffering to multiple printers, optimized printer-port drivers for PS/2 computers, and an optional pop-up menu with printer status, page-eject, and buffer control. *PrintCache*, Version 2.2, retails for \$149. Registered owners of *LaserTORQ* can receive the upgrade to the new release for \$25. LaserTools Corp., Emeryville, Calif.; (800) 346-1353, (415) 420-8777.

101 Macros Plus for Lotus 1-2-3—As well as adding 20 new macros to its original complement of 101, Individual Software's *101 Macros Plus for Lotus 1-2-3* now supports Releases 2.2 and 3.0 of the spreadsheet program. The 20 added macros allow users to do such things as add a previous choice to a range-search item, edit or save a macro library, list and print a filename table, obtain an instant map view or a print setting status sheet in Release 3.0, access an automatic file directory switch, and simulate a quick graph key in Release 2.2. *101 Macros Plus for Lotus 1-2-3* retails for \$69.95. Current owners can obtain the upgrade to the new release for \$25. Individual Software Inc., San Carlos, Calif.; (800) 331-3313, (415) 595-8855.

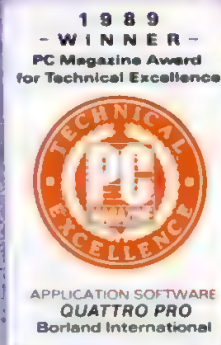
Great Plains Accounting Series, Version 5.2—Featuring more than 65 enhancements, Version 5.2 of the *Great Plains Accounting Series* offers expanded reporting and data entry capabilities in all modules. System improvements include an increased, 100,000-record capacity; an upgraded General Ledger module that allows users to generate, copy, and store unlimited financial statements and report formulas; the expansion of the Accounts Receivable module to include invoicing capabilities, an inventory database, and flexible item pricing; and the ability to calculate "tax on tax" charges in the Order Entry module. Maximum and minimum taxable amounts are now allowed on either total sale or line-item sales amounts, in accordance with local or state laws. The General Ledger, Accounts Receivable with invoicing, Accounts Payable, Payroll, Order Entry with Point of Sale, Inventory, and Purchase Order modules are available for \$795 each. Current owners enrolled in support plans will receive Version 5.2 free of charge. Great Plains Software Inc., Fargo, N. Dak.; (701) 281-0550.



Version 2.0 of *Impress* adds mouse support and DTP-style features to *Lotus 1-2-3* worksheets.

PC-File, Version 5.0—The latest release of the flat-file database manager from ButtonWare includes mouse support, an auto-dialer and phone log, PostScript output for graphs, improved dBASE index capability, multiple input screens, a maximum of 128 fields, up to nine subtotal levels, and an enhanced user interface. The new version retails for \$129.95. Registered owners of previous versions of *PC-File* can upgrade to the new release for \$39. A LAN version of the package is also available; it costs \$349.95. ButtonWare Inc., Bellevue, Wash.; (206) 454-0479.

Impress, Version 2.0—PC Publishing has upgraded *Impress*, its graphical add-in for *Lotus 1-2-3*, bringing full mouse support to Versions 2.0, 2.01, and 2.2 of 1-2-3. Furthermore, *Impress*—which allows users to customize their 1-2-3 display with drawings, colors, grids, boxes, polygons, circles, and fonts—now features a drawing toolbox and text justification, as well. Version 2.0 also automatically imports *Allways* files. Retailing for \$149.95, the enhanced package requires 90K of free RAM. Current owners should contact the company for upgrade details. PC Publishing Inc., Los Angeles, Calif.; (213) 556-3630.



THE BALANCE OF POWER: QUATTRO® PRO

	QUATTRO PRO*	Lotus 1-2-3* v 2.2 v 3.0	
PUBLISHING			
3-D Graphs	✓		
Built-in draw package	✓		
Individual cell font control	✓	✓	
Shading and borders	✓	✓	
Print graphs & spreadsheets side-by-side	✓	✓	
CONSOLIDATION			
Multiple spreadsheet windows	✓		✓
Multipage consolidation	✓		✓
Keyboard and mouse support	✓		
Lotus 1-2-3 v 2.01 compatibility	✓	✓	✓
Spreadsheet Capacity (NSTL) **	640K RAM 11 1Mb RAM 18	8 12	NA 5
Price***	\$495	\$495	\$495

*Clip art from PicturePaks™ by Marketing Graphics Inc. (MGI)**NSTL (National Software Testing Labs) measured spreadsheet capacity by counting how many years of data could be added to a spreadsheet. Large numbers mean greater capacity. Performance for v 2.2 is with Always attached.

***Based on suggested retail prices as of October, 1989.

"QUATTRO PRO seems to do the impossible: It maintains compatibility with 1-2-3; adds functionality that no version of 1-2-3 has and still runs large spreadsheets in 640K."

PC WEEK, September 4, 1989

"Borland squeezes such features as multipage consolidation, advanced linking, and live graphics into a package that runs on 512K systems with its Virtual Real-Time Object-Oriented Memory Manager (VROOMM™) technology."

InfoWorld, September 4, 1989

QUATTRO PRO, with a unique balance of power, does both advanced publishing and multipage consolidation.

Lotus 1-2-3's Release 2.2 cannot do both. Neither can their Release 3.0 (see comparison chart).

QUATTRO PRO is compatible with 1-2-3.* It comes with a built-in draw package, clip art library,* and Bitstream® typefaces for presentation-quality output.

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BORLAND

Code: MQ41

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There are two ways to get into your programs.



The DOS way.

DOS... the one way, no passing, twisted, backed-up path you use every day to get into your programs.

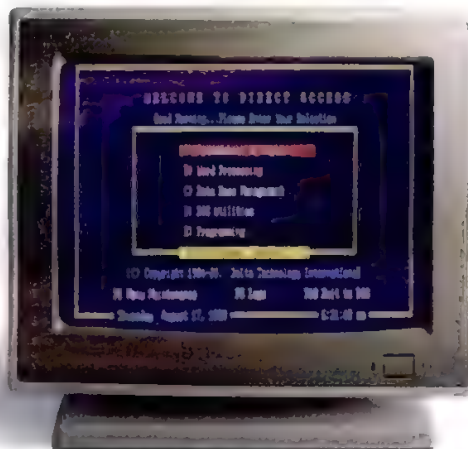
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HyperEdit

CONTINUED FROM PAGE 54

procedure names can be generated, and wildcards can be used in search queries.

Furthermore, users can perform complex searches using the package's editor language. Search criteria can include base conversion, arithmetic, and characters within a certain range. Pair-matching commands will match any parentheses, bracket, brace, or language-specific pair.

HyperEdit's built-in programming utilities include a calculator, ASCII table, screen-attribute table, and key-code display. All commands are displayed on menus, and you can create up to 20 windows to view segments of program code.

List Price: *HyperEdit*, \$69.95 (\$44.95 for educational users). **Requires:** 384K RAM, DOS 2.0 or later. Hard disk recommended for large projects. Speedywrite Software, Box 1691, 1600 Grand Ave., St. Paul, MN 55105; (612) 696-6732.

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The package includes drivers for PostScript, HP LaserJet and DeskJet, Epson, Panasonic, NEC, Toshiba, Star, IBM, and other printers. Both laser and dot matrix printers are supported.

List Price: *NewFase II*, \$149 through April 1, 1990, \$249 thereafter. Additional typefaces available, \$45 to \$120 per set of four.

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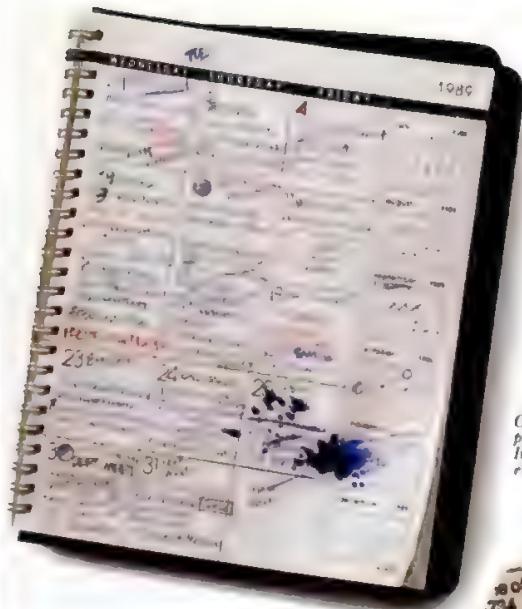
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by
Gus Venditto

Pipeline

A Look at the Trends Shaping the Personal Computer Market

New Trend on the Horizon: Vendors Want to Help Users— Or Sell Help, Anyway

Product support is about to become serious business for PC hardware and software vendors.

Anyone who's ever waded through eight-layer-deep voice-mail systems and waited on indefinite hold for the privilege of talking to someone who has no idea how to fix the bug in their new software will be forgiven if

he greets this news with a healthy dose of skepticism. But aside from talk about new products and upgrades, an increasing number of PC vendor companies are doing something about expanding service.

Jim Manzi, president of Lotus Development Corp. has gone as far as saying that Lotus will

become more of a service company than anything else in coming years.

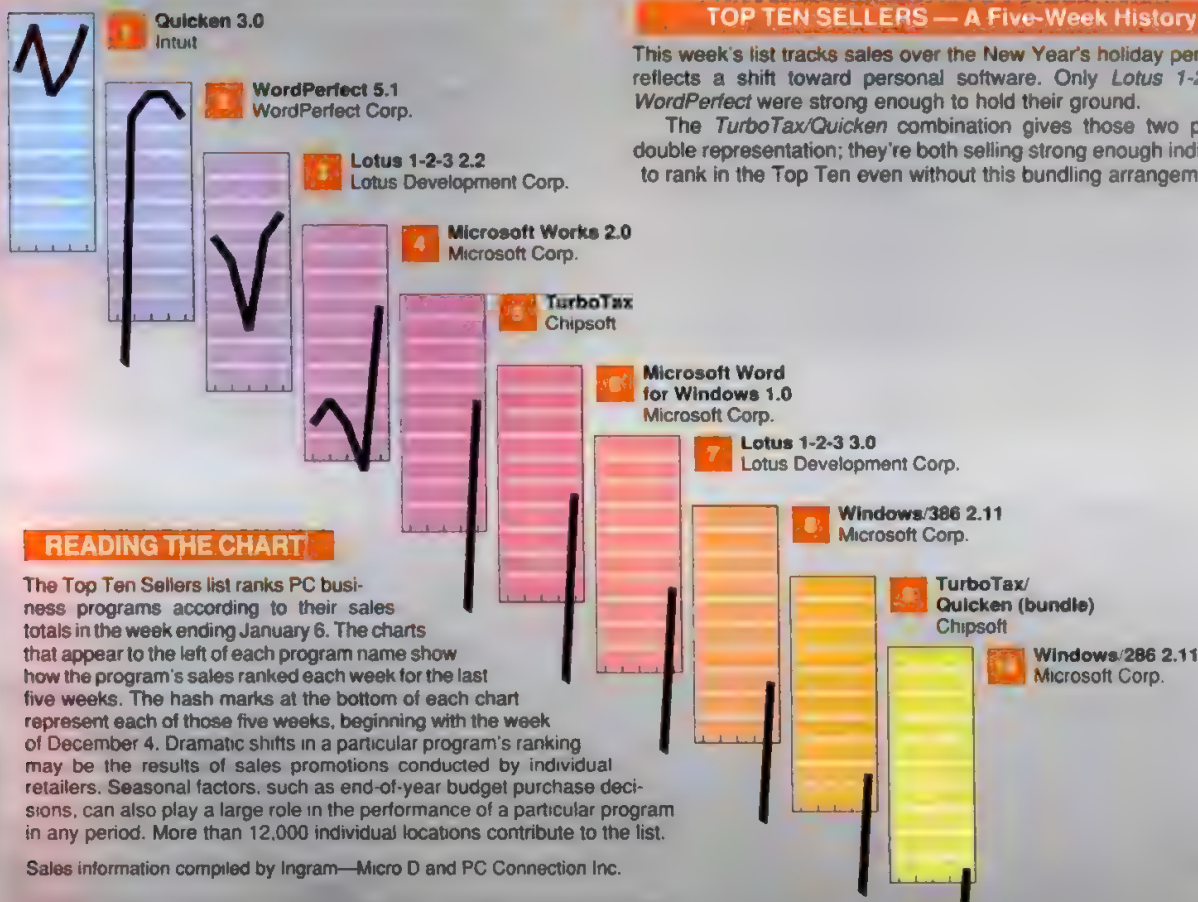
His first step in this direction is the way the company will handle *Lotus Notes*, a graphical text manager for group communications. Rather than sell the program through dealers, Lotus's own people will sell, install, and support the complex multiuser program. With a minimum charge of \$62,000 for 100 users, this may not sound like everyone's idea of progress.

Likely to be better received is WordPerfect Corp.'s new

policy of late-night support. Recognizing that users don't always keep 9-to-5 hours, the company's added a new number for technical help from 6 P.M. to 7 A.M. (Central time); it's (801) 226-6444 and is open to anyone with a technical question about *WordPerfect*.

With one-third of the company's employees providing customer service, WordPerfect clearly recognizes the value of keeping customers happy after the check's been cashed.

The company has been going
CONTINUES ON PAGE 64



Pipeline

CONTINUED FROM PAGE 63

against the grain in its support policies for years. Most software companies started in business with open-ended technical hotlines, and then cut back as their operations grew. Typically, technicians are made available only to customers with more than 100 registered users. Others are serviced through dealers or service contracts.

IBM, which sells technical assistance through annual service contracts, is adding a 24-hour, 7-day-a-week 800-number hotline for offices subscribing to the service. The IBM service covers any PC hardware and software, no matter who makes it.

Aldus Corp. is taking a lukewarm step in the direction of better support. Registered users will receive a 90-day period of free telephone support. After that, they receive the option of paying for access to the technicians or taking part in a new trend that promises to completely change software support.

An Aldus 900-number hotline will dispense technical assistance for a flat fee of \$15, billed directly to the caller's phone bill.

ButtonWare has started a similar service for *PC-File* questions, billing callers at a \$1 a minute.

It's a great idea—except for the majority of American businesses, which block access to 900 and other fee-based numbers.

Shareware Experiences Mid-life Crisis

It's been several years since the shareware concept produced a big hit, and questions about its longtime survival seem justified.

The most popular programs of the mid-1980s—including Jim Button's *PC-File*, Jim Wallace's *PC-Write*, and Marshall Magee's *Automenu*—have used the success they achieved years ago as part-time software publishers to build small companies with full-time order fulfillment and product support depart-

ments. They continue to provide pay-if-you're-pleased copies of new versions to bulletin boards while experimenting with the more traditionally capitalist business strategies.

The creators of *ProComm*, the most popular shareware communications program of the late 1980s, realized that while shareware distribution had gotten them started, it would never guide the program into the hands of its greatest potential audience. Too many users are unaware of the bulletin boards, on-line services, and user groups where shareware files are posted. Too many people were unwilling to sweat through the intricacies of unarchiving software. And many corporate managers simply won't buy a program if there's no hand to shake when the purchase is made and no throat to strangle when it doesn't work as promised.

In essence, shareware has proved to be an easy way for creative programmers to make a few dollars from their work without burdening them with the costs of a full-time business. Serious

Recognizing that users don't always
keep 9-to-5 hours, WordPerfect's added
a new number for technical help from
6 P.M. to 7 A.M.

users, on the other hand, require the support that only a serious software company can offer. And shareware authors who want to stay in business for the long haul have to build organizations that can deliver support efficiently.

The solution for *ProComm* authors Tom Smith and Bruce Barkelew was to split the business. Keep riding the horse that got them in the race, *ProComm 2.4.4*, as a shareware product and introduce a major upgrade, *ProComm Plus*, as a completely commercial product, sold only through authorized dealers and with full support. In the two years since it made that switch, the company has flourished. The shareware version serves as a

OS/2 2.0 will run multiple DOS sessions
concurrent with multiple OS/2 sessions.
It will ship before the end of 1990.

free promotional device, while the fully commercial version is arguably the most popular communications program in the country.

Magee entered retail distribution with *Automenu* while keeping the same version active as shareware. Several years later, the 29-year-old programmer has a full-time staff of 15, satisfied Fortune 100 customers, and a thriving business only 40 percent of which is shareware registration.

Now, one of the grand masters of the genre, Jim Button, has decided to go even further into retail territory.

He's hired one of Egghead's marketing hotshots and hopes to

stories setting their sights higher, the pure shareware market seems to have become a utilities arena. Virus protection, file compression, and printer enhancements are typical of the new ideas in shareware; very few shareware innovations have been in mainstream applications.

Without some major shift, that trend is likely to continue.

Toolkit for 32-bit Version of OS/2 Ships

IBM and Microsoft are proceeding at full steam on the path for OS/2. The development kit that programmers will use in writing applications for the 32-bit version of the operating system has just shipped.

The kit includes a working version of OS/2 2.0, which requires a 386, 386SX, or 486 processor.

OS/2 2.0 will run multiple DOS sessions concurrent with multiple OS/2 sessions; all applications written for earlier OS/2 versions will run without modification.

Microsoft says it will ship OS/2 2.0 before the end of 1990.

Selling the Compatible Before the Original's Created

Microsoft's page description language (PDL) for OS/2 is still deep in development and not likely to be shipped until next year. But a few vendors are already promoting printers and printer-controller boards they say are *compatible* with Microsoft's PDL. What gives?

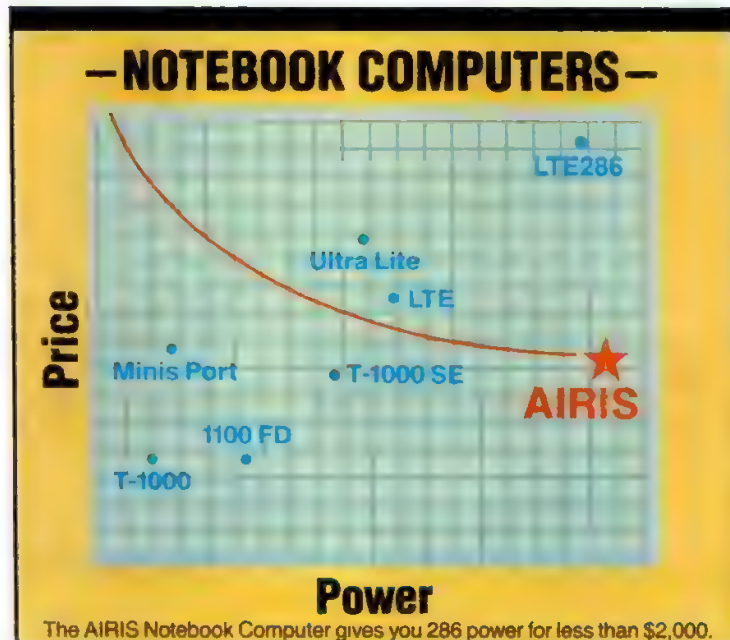
These companies licensed a PostScript clone from Bauer Enterprises, the outfit Microsoft acquired for its page description technology, *before* Microsoft bought Bauer. Anyone who thinks the Bauer printing technology won't be significantly changed by Microsoft is making an awfully big assumption.

get copies of *PC-File 5.0* on most software store shelves. Until recently, only a quarter of *PC-File*'s sales has been in stores, the rest as shareware.

Shareware publishers have to walk a fine line, since retailers don't want too much competition from a freely distributed version. One concession ButtonWare now makes is a referral of potential customers to retail stores. It's a real break with tradition for a shareware author to refer new users to a store, but ButtonWare believes it's the only way to keep its installed base growing. The company will also distribute a network version only in stores.

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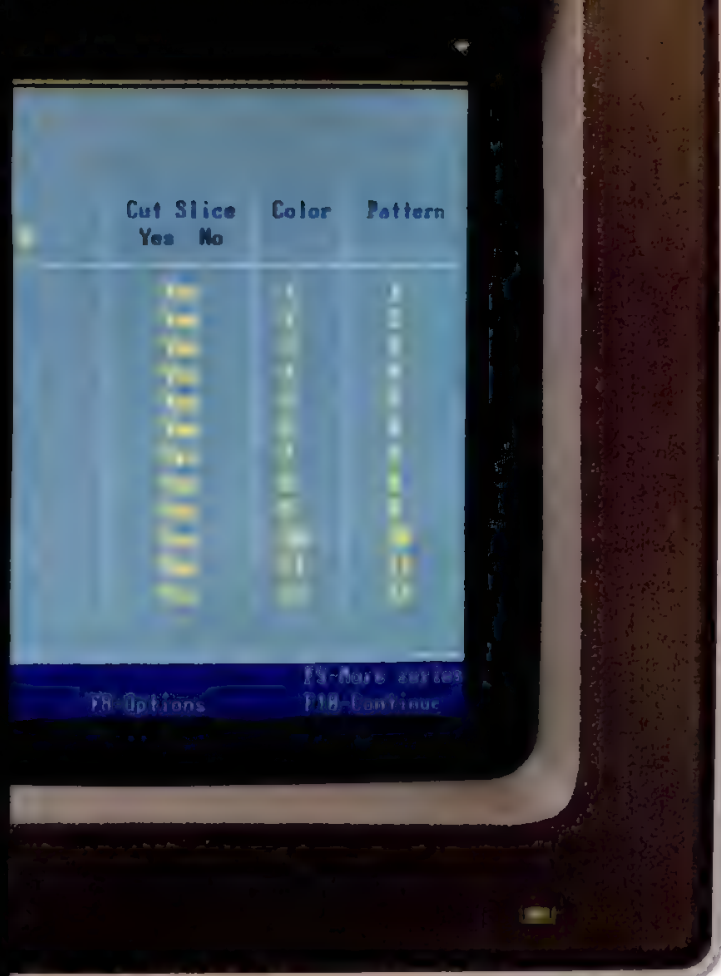
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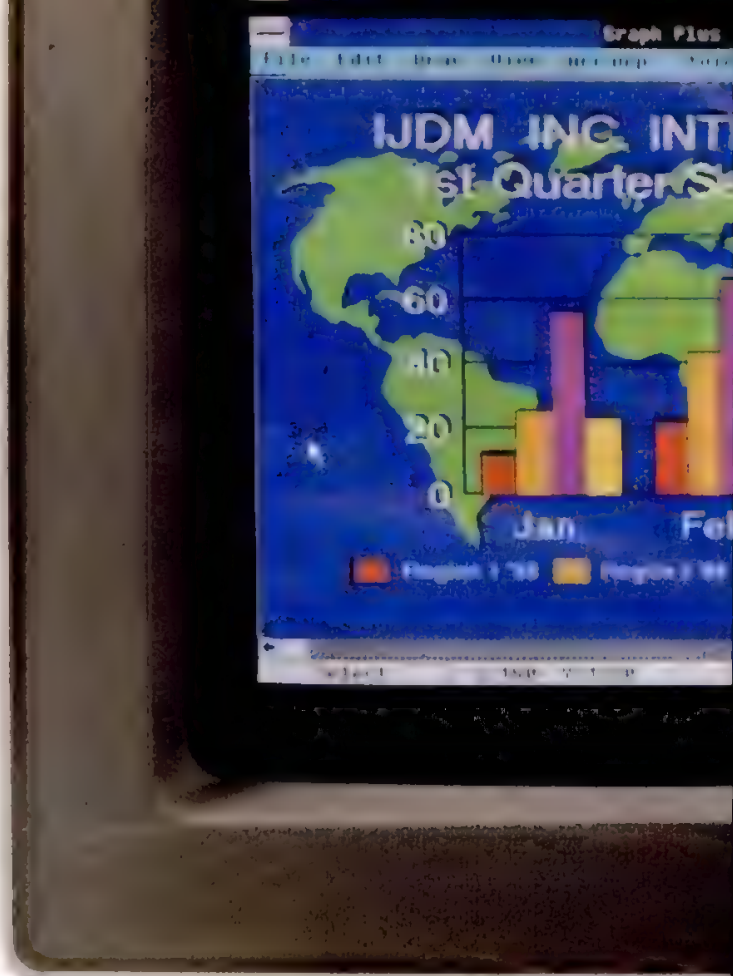
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Bill Machrone



**Things must be
getting better.
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bring a bunch of
untried software
together and
actually expect
it all to work!**

There I was, suit carrier and briefcase in hand, about to embark on a trip to Atlanta. As I said my goodbyes to my wife and kids, my 8-year-old daughter, Stephanie, asked, "By the way, Dad, can we do clip art on our computer?"

"Sure," I said. "Why?"

"My teacher asked us who had computers at home if we could design a cover for these stories we're writing. The class votes on the best design and we use it for the cover. It's called 'Our Treasured Moments.'"

"OK, we'll work on it. When do you need it?" I asked. "Friday."

Friday. Here it was, Tuesday morning; I'd be coming back from Atlanta on Wednesday night, with a stop in the office that afternoon. Thursday morning it was on to Los Angeles, to return late on Friday night. So Wednesday night was my window of opportunity.

On the way to the airport, I got to thinking about the machine at home, a 16-MHz Compaq Deskpro 386 that I'd borrowed from PC Labs as an emergency replacement for an older machine that had died. While it had *Microsoft Windows/386* installed, I hadn't gotten around to loading *PageMaker*, *Micrografx Designer*, *Arts & Letters*, or any of the other graphical software that would be appropriate for the job. And while my Hewlett-Packard LaserJet II printer certainly has the potential for excellent output quality, I knew from experience that it could be slow and that headline fonts could be a mess with the *Windows* driver.

I got back to the office Wednesday afternoon and went "shopping" in the art department. We've been using PCs for the magazine's graphics for years, and I knew that they had the expertise to get me set up quickly. I borrowed a copy of *Designer*, since I was the most familiar with it. We threw in a few of the Micrografx clip-art libraries for good measure. Our design and electronic publishing director, Gerard Kunkel, asked me about output. He agreed that we couldn't rely on the LaserJet driver to create good output.

"What you need is a PostScript printer," he said. "Why don't you and Stephanie put something together and we'll print it out for you?" I told him the problem with my travel schedule. Gerard rooted around his desk for a

while and came up with Pan Overseas' *PreScript*, a software interpreter that intercepts PostScript printer output and converts it into LaserJet commands. He also dug up a pair of boards that plug into the PC and the LaserJet and transfer data at video rates. Frankly, I didn't care one way or the other. I'd be thrilled if we could just get a page out before dawn on Thursday.

GLOOMY FOREBODINGS

Home I headed, weighed down by 20 pounds of hardware and software. I read the documentation on the train. As I did so, my hopes sank lower and lower. *PreScript* is a protected-mode TSR that loads in extended memory. But *Windows/386* takes over much of the machine when it runs. I was sure they'd conflict. Meanwhile, the *Designer* manual said that I needed to replace a number of *Windows* drivers with more-recent ones from Micrografx in order to avoid lockups and incompatibilities. Changing drivers in *Windows* requires



reinstallation. That was fine, except that I didn't have the *Windows/386* disks at home, so I couldn't reinstall it.

When I arrived, I told Stephanie not to expect anything and got to work. The disappointment in her eyes was a haunting reminder of the risks involved in getting new things to work for the first time. I installed *Designer* first, figuring that if I couldn't get to the clip art or hack together some kind of

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Bill Machrone

design that suggested Treasured Moments, I'd quit right there and salvage what I could of the evening. Contrary to all the dire warnings, both *Designer* and the clip-art disks worked fine with my old drivers, and Micrografx's PostScript driver didn't require a reinstallation of *Windows*. Then I installed *PreScript*. It, too, went in without a hitch. I was tickled when the test page emerged from the LaserJet.

So it was time for the big risk. With *PreScript* still loaded in extended memory, I started *Windows/386*. Which, of course, died, averring that the machine had insufficient memory. Sure, I can see how 6 megabytes isn't enough to hold *Windows* and *PreScript*. I rebooted the machine, figuring that a fresh start might do the trick. It didn't.

Clearly, I needed to reinstall *Windows/386*. Except that reinstallation wasn't an option. So I did the next best thing. I ran *WIN86.COM*, which loads a single real-mode copy of *Windows*. It warned me that I had changed the machine's memory configuration and that I should reinstall *Windows*, but that was old news. At least it worked.

Next, I ran *Designer*. Instead of the 4 megabytes or so that I was used to having under *Windows/386*, *Designer* could scrape up only about 200K in which to manage its overlays and the graphic image. I hadn't seen an application run so slowly since I retired my old XT. The disk drive light came on and stayed on almost the entire time, as *Designer* and *Windows* swapped stuff in and out of memory.

But, amazingly, *PreScript* worked exactly as advertised. I was rewarded with a couple of beautiful images and an ecstatic 8-year-old. Despite *Designer*'s slow performance in its hampered mode, *PreScript* printed the images quickly and without difficulty.

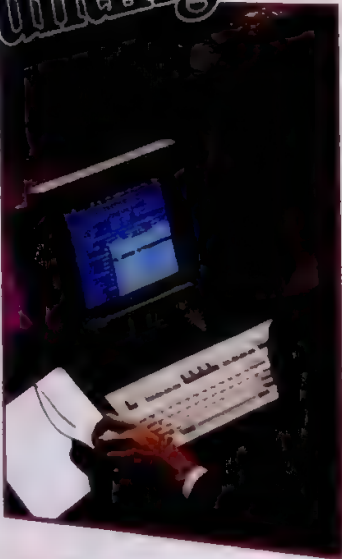
After the smoke cleared, I began to wonder if I had not, in fact, wasted the whole evening. After all, didn't *Designer* have a PCL driver for the LaserJet? So I disabled *PreScript* and printed the image (a dense one) using the PCL driver. Twenty minutes later, a page finally emerged. The image was noticeably lower in quality and the typography was a complete mess. You can bet I'll be doing a complete reinstallation of *Windows/386* and *PreScript*. The right tools are worth it. ■

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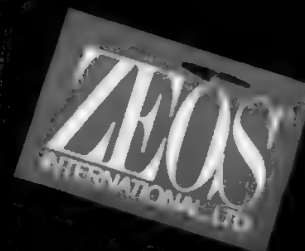
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John C. Dvorak



**Computerphobia
is insidious
in our society.
Can you trust
anyone over 45?**

Computerphobia. We are now into the sixth decade of the computer era. We are entering the second decade of the age of personal computers. And still there is a generational gap concerning these machines. It seems to hover around the 45-and-older crowd. This group has never cared about computers and has been frightened by PCs since their inception.

It's like a New Guinea tribesman being frightened by an escalator. Everyone who uses escalators understands them and knows how easy they are to use. You just step on them. But to the tribesman they are somehow magical. Foreboding.

In an effort to avoid facing this scary new technology, the computerphobes have taken on an aggressive anticomputer attitude. Ask around and you'll hear, "I hate computers." "We rely too much on computers." "I don't know how to use one and don't care to learn." It doesn't matter that any 12-year-old can become proficient with a computer in just a few hours. Do they understand that a 12-year-old is *not* smarter than a 45-year-old?

But what mechanism exists in computers and their use that parallels the sociological mechanisms that make people afraid of water or heights? Computerphobia, if it is a genuine phobia, is one that isn't being taken seriously. I know of no psychologist who studies the phenomenon, though it's a threat to the progress and competitiveness of our country. Falling behind in science and engineering is a direct result of computerphobes in high places. Blame it on TV and the movies.

Adults get many of their cues for such fears from the media and the cultural stereotypes promoted by it. TV personalities, many of whom are over 45, reaffirm computerphobia by making public statements about their computer illiteracy. Ted Koppel on "Nightline" is a perfect example—he pleaded ignorance publicly on a show featuring Steve Wozniak. Apparently Bryant Gumbel on the "Today" show is fearful of computers too, because someone raided his files and publicized a critical letter.

In newspapers all around the country, editors love to run columns about gardening, but they are fearful of computer columns, despite their attractiveness to advertisers. They aren't

completely to blame. The entire editing infrastructure makes it hard to edit any technical columns, since few editors have any technical knowledge. This puts the problem right into the classroom, specifically into the college classroom, where computerphobia is part of academia.

IT STARTS IN THE CLASSROOM

While many of today's students are computer savvy (better systems are to be found in dormitories than in campus departments), the academic system prefers to ignore computers. Students could be doing research from central databases and putting together fantastic reports. None of this is encouraged. Computers are seen mostly as fancy typewriters.

Most phobias generate their dread from fear of harm to one's physical being. Fear of heights equals the fear of falling to one's death. But what can possibly be the deep-rooted subconscious rationale for the fear of computers? It must be related to fear of humili-

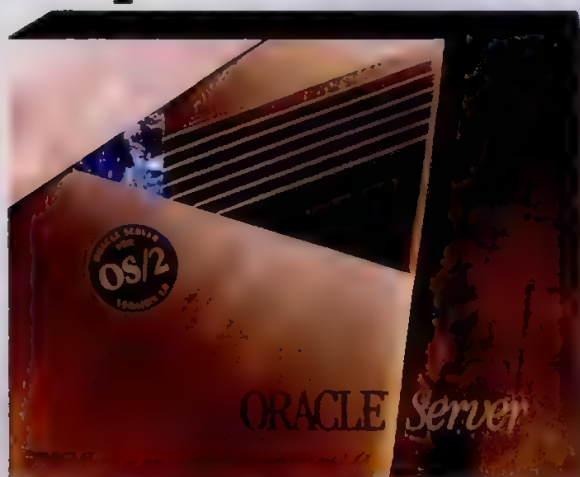


ation or fear of damaging something. Many people are afraid they'll wreck the computer if they touch it. Then they may be harmed because of it. Beaten up by the owner, perhaps.

Hopefully, as computer literacy becomes more and more important, the fear of losing one's job because of computer incompetency will win out. Until then, let's all find a computerphobe and show him or her how to boot a PC. It's the least we can do for these pathetic souls.

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show it to be slower.

Inside Track

If you've seen those little 3-inch CDs (they usually contain about four songs) in your local record store, then you may have seen the **future of CD-ROM**. Expect to see **3-inch CD-ROMs** in the next year that hold about 200MB of data. While you can read them with a regular CD-ROM drive by popping them into an adapter, the idea is to reduce the size of the CD-ROM drive so that it can be placed in a 3-inch drive bay in your desktop or laptop PC.

Already, **prototypes** of laptops with the diminutive new drives have been shown. Some pundits feel that this will be attractive to certain professionals such as insurance agents, real estate salespeople, and accountants. With a CD-ROM-equipped laptop and a briefcase full of little disks containing actuarial data, photos of houses, or tax-law idiosyncrasies, these people should be able to do most of their work away from the office.

CD-ROM technology may get another boost when a **new version of MS-DOS** is released this year—one that includes **CD-ROM drivers standard**. At this writing we are still stuck with hopeless device drivers to get the mechanisms to work. I have never been able to get a CD-ROM up and running on my 386 machine, and the people I know in large corporations who have tried to implement CD-ROM systems in-house also have **horror stories** about incompatibilities. And if you want to attach a CD-ROM to a network... well forget it!

Meanwhile, as the CD-ROM scene begins to heat up, Microsoft has passed off the management of its own **CD-ROM conference** to Cahners Exposition Group. Now, members of the press must apparently pay to get in. This will certainly get them a lot of free publicity. Since there's been **little news** in the CD-ROM scene for the past couple of years, this development may be the last **nail in the coffin** of a conference that began to stall a couple of years ago.

OCR Dept.: While I'm a big fan of Caere Corp.'s *OmniPage*, I keep an eye on Calera Recognition Systems and the Kurzweil subsidiary of Xerox Imaging Systems, the two other important players in the optical-character-recognition market. While *OmniPage* does the **best job** for me, it's important to note that a product designed by Kurzweil, sold under Xerox's Datacopy brand name, and called *Accutext*, is the only OCR software that can read **dot matrix print** with any accuracy. I've only seen it work on a Macintosh, though.

There are two other features that you should notice about the more-elaborate Kurzweil-branded systems. The scanner's resolution is **400 dots per inch**, not the 300 dpi that is typical for the PC world. This seems to help. Even more inter-

esting to me is that on a flatbed scanner, you can put the edge of the scan window right up against the edge of the unit, letting you drape a book over the side and tuck it into the scanner. Even page 345 in a **fat book** lays flat and is thus completely scannable. All scanner makers should adopt this idea.

Word on the Street Dept.: I haven't played around much in the *dBASE*-compatible world since the introduction of *dBASE III Plus*. If you're wondering **what's hot** and what's not, I'll tell you what all the insiders are saying. Spell it F-O-X-P-R-O. *Foxpro* is the hottest product out there. "It's what *dBASE IV* should have been," say the users. End of unsolicited plug.

Downloaded from the CompuServe Dvorak Forum on PC MagNet Dept.: "Fm: Kevin R. Grantham, S6/Views:Dvorak, Sb: #59892-#New AMD 286 chips... What I would like to see is for Harris to come out with a 286 that has the All Chargecard memory management circuits on-board the chip. Couple that with some instruction cleanups (fewer cycles) and 20-MHz-plus speeds, and one would really have an SX killer!" **Interesting idea!** But maybe it's time we buried old Gertie.

The Xerox-Apple Suit Dept.: I hope we all know that **Xerox has sued Apple** for using its Star technology in the Macintosh. Maybe someone at Xerox finally read **page 161** of the John Sculley book, *Odyssey*, where Sculley, while talking about the Mac development team says: "Most of the Macintosh technology wasn't invented in the building. Indeed, the Macintosh, like the Lisa before it, was largely a conduit for technology developed at Xerox PARC." **A conduit?** This is a real candidate for the **Genuinely Interesting English Usage Dept.** Kind of a freewheeling attitude, for a company that **sues the pants off** any small-time operators who try to import Taiwanese clones of Apple IIs, don't you think? Hey, John, they were just "conduits!"

This suit should end Apple's **death grip** on the graphical user interface. Xerox is itching to license something, anything! Apparently, when Bill Lowe came over from IBM, he **nearly died** from heart failure when he saw all of the inventions made at Xerox PARC that were **languishing** and not being licensed. Worse, its patents weren't being properly enforced.

With everyone suing everyone else these days, perhaps Nintendo will be the only survivor. Not with its big machine, over which it's being sued (for adding chips to keep out foreign cartridges), but with Game Boy. Next we'll see **Spreadsheet Boy, Word Processing Boy, Database Boy**. I don't think Xerox invented any of these ideas. Kudos to David Frier for this observation. ■

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suing everyone
else these days,
Nintendo
may be the
only survivor.

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Not only does the Model 12 perform like a desktop PC, it feels like one, too. The AT®-style keyboard provides full-size, full-travel keys that give your fingers plenty of room and great response.

Other advantages include an easy-to-read, backlit LCD screen that your eyes will appreciate. For additional flexibility and convenience, snap on a 3.5" high-density floppy disk drive, or remove it and travel light. Then send work to your office with just a phone call, thanks to an optional internal modem.

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Jim Seymour



1992 may be the best thing that ever happened to U.S. PC makers, as a Europe-wide market opens—with no European competition in sight.

The U.S. financial community has been abuzz with Eurofever for some time. Now, that curious disease, an intense concern—even worry—about what will happen when the European Community drops its internal trade barriers in 1992, has also begun to infect the personal computer industry in this country.

A number of bad-news specialists say that U.S. PC makers already established in Western European nations will face tough and perhaps overwhelming new competition there from Europe-wide PC conglomerates and consortia. They even claim that these new European entities will be able to march into the U.S. with enough force to change the game here, too.

I've spent a lot of time traveling and asking questions in England and on the continent lately. I want to try to debunk some of the myths that are starting to take hold here about the European market and the way its reorganization will affect U.S. computer companies and computer users.

Remember that until very recently there was great skepticism that the European Community (EC) actually *would* drop the trade barriers among its members in 1992. Indeed, some say there's a good chance that Mrs. Thatcher or another foot-dragger on EC cooperation will manage to delay the 1992 changes. There's enough momentum behind the idea of open trade, and enough advance planning in place, that I think we'll see the changes that have already been agreed on. But the friction over 1992 among EC member countries should alert us to just how fractious, divided, and wary they are over this move.

This fact alone argues against the early emergence of an integrated, cohesive pan-European personal computer company with enough financial, technical, and marketing clout even to overturn existing market shares in Europe, let alone to bring new products, strategies, and pricing to the U.S. with any great effect.

Who are the big players in the European PC marketplace today? Well, there's Amstrad, which dominated the U.K. market two years ago and did well on the continent too. Cheap XT clones pushed Amstrad to a 10.5 percent share of the European PC market. Then came R&D problems with 286 and 386 machines, and Am-

strad's market share plummeted. Today the company claims less than 5 percent of the European market, and its stock has fallen by more than 80 percent.

Amstrad doesn't sound to me like much of a threat to U.S. PC makers. Nor does it sound like a company that could form the core of a powerful European assault on U.S. markets.

LEADERSHIP VACUUM

The other big European PC maker is Olivetti. After years of waddling along with a series of uninspired, continually obsolete machines, this company has now come alive with the return of Vittorio Cassoni—who once led AT&T's PC efforts in the U.S.—to the top job at Olivetti's computer operations. Cassoni is smart, can read markets, and knows how to crack the whip in R&D. As a result, Olivetti now has a respectable series of 286 and 386 PCs, one of the first 486s, and a generally good reputation. It has a modest share of the European market



ILLUSTRATION: JOHN HART

and is likely to increase that share after 1992. But it's not nearly strong enough to dominate the market.

Other possibilities? Nixdorf, the German mainframe giant, has shown little understanding of the PC market. Ericsson, its Scandinavian counterpart, tried and gave up. France's Compagnie des Machines Bull may be a player, now that it has purchased Zenith's PC line, but it's a long shot.

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Jim Seymour

Who, then, are the big winners in PCs in Europe? IBM, of course. Compaq, which early on understood the importance, and the complexities, of foreign markets. And, surprisingly, some big American mail-order companies. Both Dell and CompuAdd have opened European operations over the past two years. Dell, in particular, has become a force in the U.K. and Germany, and it recently opened Dell France.

A European Community without trade restrictions for European-produced goods but with very high trade barriers for *non-European* goods might seem a hostile place for U.S. companies to compete. But the American companies have already Europeanized their operations, building in each country the PCs they sell there. That will qualify them for trade treatment as EC locals.

Toshiba taught them how to do that. When the U.S. rattled its economic swords three years ago, erecting tariff barriers to Japanese PCs, Toshiba set up a California plant in record time and shifted its production of U.S.-market machines there. Since the labor component of building a PC is only a tiny fraction of the total cost, relative labor costs from market to market are almost irrelevant.

What about software? Well, let's name all the top-selling European-produced PC software packages. Finished? The only one I can think of is *4th Dimension* for the Macintosh, which came from France. And even that's a bit of a reach, since it was Californian Guy Kawasaki's marketing savvy that made *4th Dimension* the modest hit it is, before he left the company late last year.

A PROMISING FUTURE

Far from posing a threat to U.S. PC makers, a united Western Europe represents a huge opportunity for them. The U.S. companies have the mass-production and marketing experience that are needed to win in such a huge, heterogeneous market. Few European companies have those skills now, and they're not likely to develop them overnight simply because trade barriers fall.

Add to this the possibilities opened by the astonishing opening of Eastern Europe this winter, and the prospects for U.S. PC companies in Europe during the 1990s look very bright indeed. ■

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William F. Zachmann



OS/2 will eventually become the standard. But in the transition period, Windows will be a useful option for many users.

In an ideal world, all choices would be simple, straightforward, and obvious. In the real world of PC operating systems, it doesn't work out that way. Ideally, the transition from DOS to OS/2 should have been easy, a matter of a single migration step. In practice, the transition will be far more convoluted and less immediately obvious for most users.

Don't get me wrong. The simple fact that we're going *from* DOS *to* OS/2 is a reliable indicator. But it's not enough for users to be able to navigate safely in the waters of the transition. In fact, it's a bit like sailing through the tide changes around Cape Cod. Even if you know whether the tide is coming in or going out, you still need detailed charts to know which way the water is flowing at the point where you happen to be. Make the wrong assumptions on insufficient information, and the next thing you know, you'll find yourself standing still against a strong current!

Similarly, while DOS is clearly the starting point and OS/2 is almost as clearly the final destination, there are many possible routes for getting there and major questions about the timetable for the journey. There remains, as well, the possibility that OS/2 may not be the ultimate destination. Several options are available now, each of which represents a substantial range of additional possibilities. Let's take a look at them.

First of all, the reality is that DOS is what the overwhelming majority of people use today. A 286- or 386-based system running character-mode applications like *Lotus 1-2-3* or *Word-Perfect*, and maybe a *dBASE* application or a TSR or two, is the center of gravity for PC use today. That's easily seen from the market statistics.

A significant minority of these DOS systems are being used with some form of DOS extension technology, from LIM 4.0 expanded memory and virtual disk drivers to sophisticated and powerful products like Quarterdeck Office Systems' *DESQview*. All of these offer, in varying degrees, a way to partially overcome DOS's memory limitations and its lack of multitasking capabilities.

While arguably another extension of DOS, *Microsoft Windows* is better understood as a

distinct option. Since it was introduced in 1985, *Windows* has represented an important step on the way to creating a standard graphical user interface environment for IBM-compatible systems. While *Windows* was initially slow to gain acceptance, advances in hardware and graphics technology have made it a major factor in the marketplace in the past year. Though *Windows* is still confined to a minority of DOS systems, the number of *Windows* installations is now well over a million and growing rapidly.

HEAVY HITTERS

OS/2, with or without Presentation Manager, is the third major option. Introduced in 1987 but available in a practical form only recently, OS/2 and PM provide extended addressing, multitasking, and other advanced features, plus a consistent graphical environment.

Taken together, OS/2 and PM offer much more than DOS or *Windows* possibly can. But

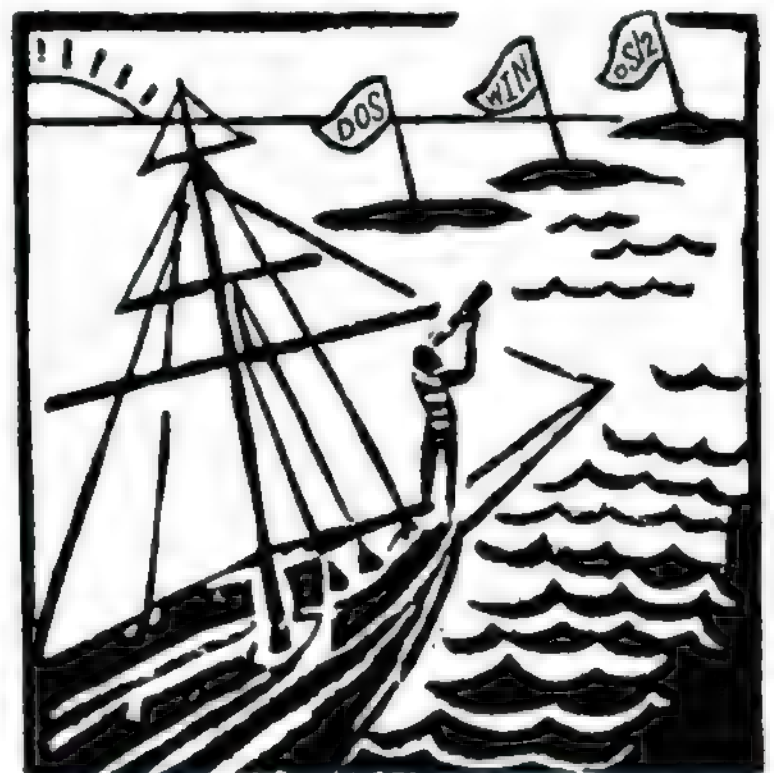


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they also require resources well beyond what is found on the typical office desktop. Older 8088- and 8086-based systems, of course, can't run OS/2 at all. Even the fastest 286-based systems are no more than marginally adequate at running OS/2 and PM, and a fair number of existing 386 systems lack sufficient memory and disk capacity to make use of OS/2. Even a fast 386 system with a VGA graphics adapter can leave something to be

William F. Zachmann

desired when it comes to applications that require high-speed text scrolling under Presentation Manager.

So while OS/2 is certainly gaining momentum as applications begin to hit the market, and as Microsoft and IBM finally finish the printer drivers and other

system pieces required for real-world use, it isn't going to be a feasible option for a very large proportion of the existing installed base. Though OS/2 will start to grow rapidly in the months ahead, a long time will pass before it can become the de facto standard for personal computers, the way that DOS has.

All of this adds up to a prolonged period during which both organizations and individual users will have to deal with

multiple operating environments and the trade-offs and choices among them. It may not be the ideal world we'd like to have, but we've got to live with it. So what's an individual or corporate user to do? What is a reasonable approach to sorting through all the options and finding a reliable course through these uncomfortably troubled waters?

First off, don't embark on the journey unless you've a reason to do so. If DOS is doing everything that you need, don't worry too much about changing environments just for the sake of changing. Let others venture out into uncharted waters for you; you can profit by their mistakes. On the other hand, if you really need the maximum that PCs can offer, and can afford it, go ahead and make the leap to OS/2 and Presentation Manager. That's what a growing number of the more advanced organizations and individuals are doing. No other option can provide as much in the long run.

For those who want to move beyond DOS, but who aren't yet ready to risk a full-scale commitment to OS/2, *Windows* is an excellent intermediate step. Especially where a complete shift to powerful 386 and 486 systems is not practical because of budget constraints, *Windows* can give you the "look and feel" of OS/2 without the high costs of buying OS/2-capable systems. *Windows* may be "training wheels for OS/2 PM," as I've characterized it in the past, but an awful lot of skinned knees have been avoided with training wheels!

And *Windows* will be an even more promising option if Version 3.0 lives up to the expectations that have been created for it in press accounts prior to its official announcement by Microsoft. Its ability to run multiple applications in protected mode on 386 systems should more than make up for the inconvenience of having to upgrade your existing *Windows* applications.

FULL CIRCLE

Over time, the real world is likely to get closer to the simplicity of the ideal world with which we started. By the middle of the nineties, by which time OS/2 will have achieved a status comparable to that of DOS today, we'll look back on this period the way sailors look back on a challenging voyage. In retrospect, it will seem simpler and more enjoyable than it did when we were hanging over the rail in the middle of a storm! ■

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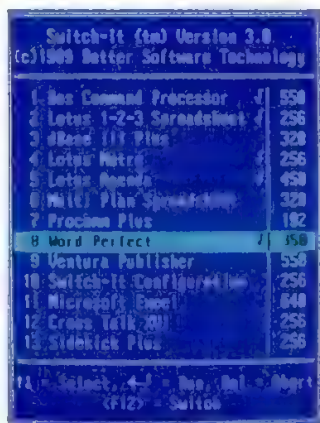
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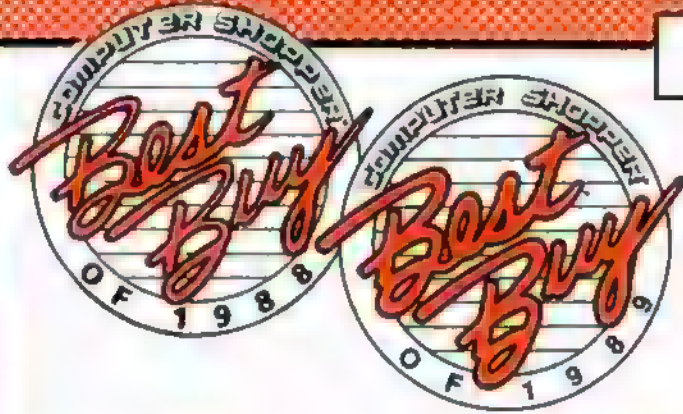
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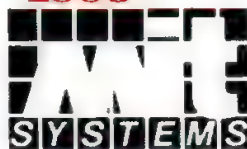
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Standard Features	XT-10	286-12	386SX-16	386-20	386-25
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Speed (MHz)	10/4.77	12/6	16/6	20/8/6	25/8/6
Bios	ERSD	Phoenix	AMI	Phoenix	Phoenix
Norton SI Rating	2.1	13.4	19.01	23.0	30.5
Wait State	0	0	0	0	0
Standard Memory	640K	1 MB	1 MB	1 MB	1 MB
Shadow Memory	-	-	-	64 K	64 K
Cache Memory	-	-	-	32 K	32K
Co-Processor Slot	Yes	Yes	Yes	Yes	Yes
Expansion Slots (8 bit)	8	2	2	2	2
Expansion Slots (16 bit)	-	6	6	5	5
Expansion Slot (32 bit)	-	-	-	1	1
FD/HD Controller	W/HD	Yes	Yes	Yes	Yes
Device Bays	4	3	3	5	5
Serial Ports	-	2	2	2	2
Parallel Ports	-	1	1	1	1
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Stephen Manes



**It's war out there
on the software
and hardware fronts!
Our brave military
correspondent
peers into the
sound and fury and
figures out what it
really signifies.**

What? Can't (Whirwhirwhir) hear you! Huh? Bus (Ptoom!!!) wars? Operating system (Flee-Yyyyyoooouu!!!) wars? Graphical (Blitblitblit!) user (Shhhheeeewww!) interface (Aieeeeeee!) wars? Spreadsheet (Knackaknackaknacka!!) wars? Word processing (Tickticktick!) wars? Database (Zzzzzzzzt!!) wars?

Hang on! Let me see if I can take cover!

Whew! It's getting so hot out here the boss ought to offer combat pay. Now, what do I think about *what*? Oh—all these endless wars!

Well, I'm a little hoarse from all this dust, but I'll tell you: First, how can you complain about good old all-American competition? Hey, what loyal, red-blooded citizen can even get all worked up over good old all-American hyperbole?

But you really want my take on this? Okay: these overhyped industry wars may have an effect on certain corporate profits, but for most computer users, they're about as important as the war between Coke and Pepsi or the war among the TV networks. To most computer customers, the value of these wars is about the same as the value of the wars of sovereign nations to most of their citizens—tiny.

I mean, entire forests have been clear-cut just to print the latest bulletins from the ISA versus EISA versus Micro Channel front. Warplanes drop press releases over major media centers on an almost daily basis. Yet after all this and more, a few thousand people who can truly take advantage of the kind of speed an EISA or Micro Channel machine is potentially capable of will have to filter through the barrage of disinformation, do some serious thinking, and come to what they hope will be an informed decision about where to invest their companies' cash. We happy millions whose microprocessors are generally idling while we try to remember how to recover a mistaken deletion can safely plug our ears, keep our hairlines below the fray, and go about our business.

Duck! They're firing from all sides!

Never mind—they were just blanks. Now where were we?

The GUI war? Well, that one's of somewhat more interest, even though it's been cooled down slightly by the apparent IBM/Microsoft cease-fire on the PM/Windows bat-

tlefield. Above that combat zone, however, looms stout Fort Macintosh, and distant rumblings have been heard from Unix fronts just over the NeXT hill.

SOUND AND FURY?

This particular battle zone opened up long ago, when hundreds of thousands of people figured out that a Macintosh really is significantly easier to get up and running than any known IBM PC-compatible or Unix box. Despite all the smoke and thunder from *Windows* and *PM*, the ease-of-learning (and maybe even ease-of-use) high ground remains firmly under the pennant with the shield of Apple rampant on a field of cola.

Windows may (as Microsofties are quick to point out at every opportunity) be selling faster than Macs, but many of those *Windows* units are turning up on the computers of people *forced* to use them in corporate settings. There's a growing suspicion that in-house programmers use *Windows* and *PM* mostly to gussy up



ILLUSTRATION: JOHN HART

the same kinds of miserable applications they've been handing users for decades.

But people just *adore* their Macs. Ask yourself when was the last time you heard anybody say, "I love my *Windows* (or *PM*) machine. It's so easy to use, and I have no trouble learning new applications!" Right. Not since the Maginot Line.

Besides, sneaky, lumbering saboteurs continue to subvert any GUI's march to world

Stephen Manes

domination. The first antagonist is that seasoned fighter, the character-based application, a grizzled veteran whose propaganda machine insidiously asks, "Where is it written that every hunk of data on the planet requires seven gazillion fonts, proportional spacing, and radio buttons?"

A pretty good case can be made that most of the database applications currently in existence won't necessarily benefit from font-filled entry forms or the ability to manipulate 16 million colors. Look at the drop-down menus and other goodies in, say, *FoxPro*'s character-based interface and you begin to question how much a full-fledged GUI would add. Sure, some applications do cry out for GUIs. But for many, the overhead (both in performance and in expense) a GUI imposes is highly unlikely to be offset by significant productivity gains.

Another saboteur is the great gray army of all those supposed "platforms of the past," the "brain-dead" 8088, 8086, and 80286 machines supposedly relegated to

zombiehood by the advent of newer, GUIer models. Many companies are shipping these machines out to the hinterlands of secretaries' desks. But others, particularly the parsimonious ones, are still using, and even buying, these "walking corpses."

Despite the industry's claims of hopeless obsolescence for those machines, users find them cheap and more than adequate for the workmanlike jobs—word processing, accounting, data entry, spreadsheets—they've been doing since the 386 was a mere glint in Intel's eye. Put a GUI on these machines and the overhead instantly makes them *less* productive. And the benefits a GUI supposedly brings may not translate into enough productivity to justify scrapping the old machine and buying a new one—especially if (or should that be *when?*) a recession arrives.

So who, besides a software manufacturer, needs to worry about the GUI wars? When there was one widely available GUI, GUI lovers flocked to it. Now that there are GUIs aplenty, it may take a genuinely useful application that runs only on a single GUI (as was the case with the Macintosh in the early days of *Page-*

Maker, which later helped sell a whole lot of copies of *Windows*, as well) to win the fray. Until then, think Beirut—a wildly unstable situation with outbursts of fire possible anytime from anywhere.

(Sizzzzzz!) See? *Those* rounds are definitely live!

HOLDING ACTIONS

And what about all the other desktop wars so fondly reported in the press? At this point, application positions are definitely entrenched, with less winning going on than pitched battles to hold current positions. Once an application gains a diskhold on an individual desktop, that desktop is unlikely ever to be truly won. It can, however, be lost to the enemy—as the sagas of *WordStar*, *VisiCalc*, and *dBASE* prove—by forces that fail to receive periodic resupplies and reinforcements. Otherwise, a serviceable application will stand its ground despite the best efforts of sly propaganda ministers to foment disappointment and dissatisfaction.

Hey! Get away from that machine! I don't *want* a new spreadsheet! I don't *need* an upgrade!

These wars are heck. ■

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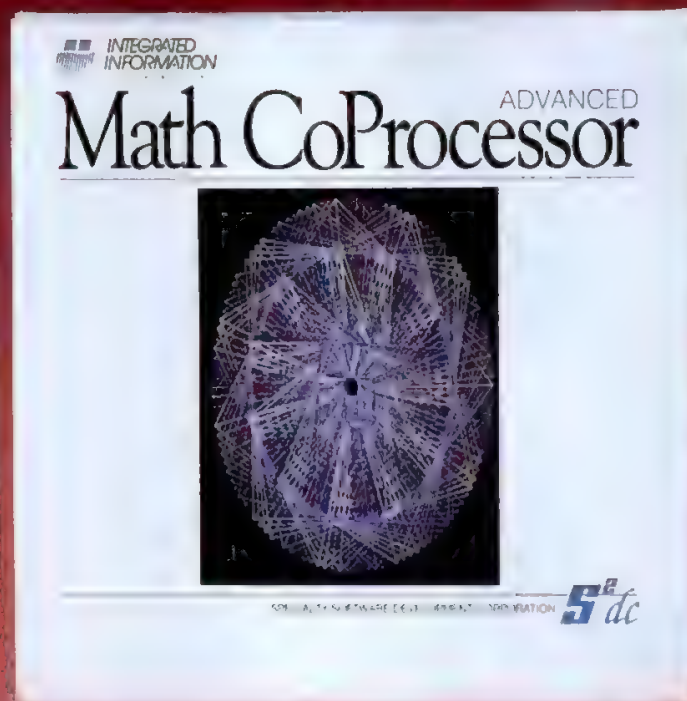
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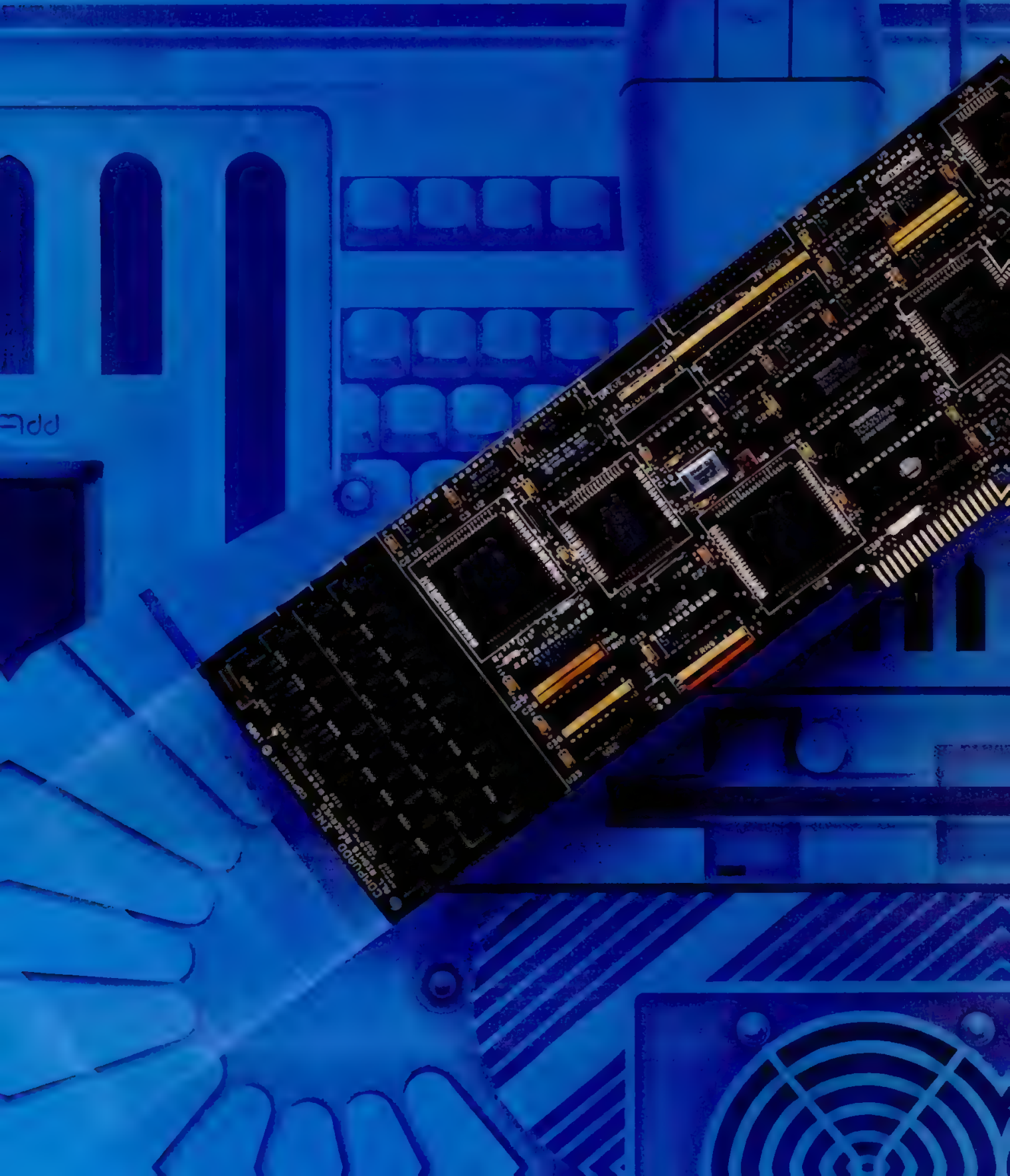
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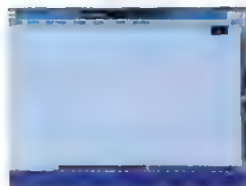
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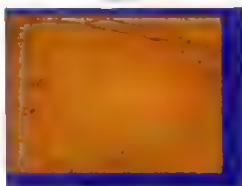
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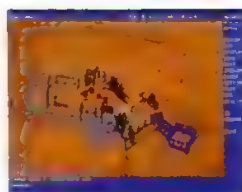


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THE NEXT PC YOU'LL BUY

by Bill Howard

This issue of *PC Magazine* is all about your next PC: the laptop, portable, or transportable computer. In a nutshell, portable PCs can provide essentially all the computing power required by the vast majority of PC users today. That's why they're so hot—and that's why this issue is devoted exclusively to portables.

One out of every eight PCs sold today is a portable of some kind. The DOS-to-travel market is growing three to four times as fast as the desktop PC market (see the chart "1989 Market Share"). The sales numbers for portables look like the computer industry figures from the go-go days of the mid-1980s: 33 percent growth in 1989; 22 percent growth projected for 1990, with 1.2 million unit sales (14 percent of the PC market), according to International Data Corp.

You can argue endlessly about how many segments exist in the DOS-

to-travel arena. In addition to laptop, portable, and transportable categories, you've got luggable, hand-held, pocket organizer, notebook, and DOS-companion portables. You can also segment the market by processor type, by overall weight, by expansion capabilities, and by battery versus AC power.

Fundamentally, there are only two types of portable computer. A portable can be either:

- your only computer, or
- a traveling adjunct to the PCs in your office and home.

If a portable PC is your only PC, you're going to need a suitably powerful tool with an 80386 or 386SX processor (possibly a 286—but more on that later), a husky hard disk, a VGA display, and a keyboard with few compromises. In other words, you'll need a machine with all the features you'd expect to find on a desktop PC—plus a handle. Compared with similarly equipped desktop PCs, you should expect to pay 15 to 20 percent more for the convenience of portability. In some cases it can be a lot less.

If you've already got a 286 or 386 PC in the office, then you may not need the ultimate portable with its penalties of weight, bulk, power consumption, and price; you can get away with a 286 processor or a fast 8088/8086. These sub-386 machines most likely provide both battery and AC power, even though they probably won't ever be used more than 10 feet away from a 120-volt outlet.

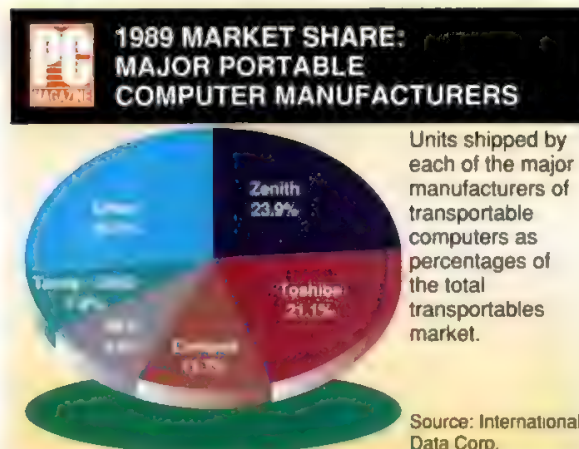
PORTABLE HISTORY

It was a portable computer that created the first serious competition for IBM's fledgling desktop PC. The portable was created by a group of former Texas Instruments engineers whose original business plan was less ambitious: they wanted to build add-in devices for the original IBM PC. Venture capitalists instead preferred their alternate plan: an all-in-one PC in a 28-pound box approximately the size of a sewing machine.

The first Compaq portable, which had two floppy disk drives and 256K of RAM, was introduced in November of 1982 and cost \$2,995. Now you can get the same power in a 12-pound unit without paying much over \$1,000.

For the features section of this issue, the associate editor was Mary Kathleen Flynn, and the PC Labs project leader was Abe Rosner.

The first serious battery-powered MS-DOS portable PCs arrived in 1985. That was a time of 15- to 20-pound lunchboxes with dual 5.25-inch floppy disk drives, typified by the Zenith (née Morrow) Z-171 that won a much-publicized contest to supply the IRS with portable audit tools. Hard disks weren't feasible yet on battery-



powered machines because they consumed three to four times as much power as the rest of the system. At the beginning of 1986, Toshiba launched the T1100—the first of the serious clamshell laptop portables with 3.5-inch floppy drives—and ignited the fierce competition that continues today.

Another seminal machine was Zenith's battery-powered Z-183 clamshell portable, with a dazzling (for the time), big 8-by-6-inch backlit screen. The Z-183 shared a *PC Magazine* Award for Technical Excellence in 1986 with the AC-only Toshiba T3100, which brought 286 power and a hard disk to a laptop configuration.

By 1987, engineering advances cut the power drain of a hard disk to about half that of the entire system, about 5 or 6 watts on a 10-watt system. Today, it's the backlighting that draws the bulk of a portable's power, followed by the hard disk, then the system electronics.

IBM made two unsuccessful early forays into the portables market, first in 1984 with the suitcase-size PC Portable—an unabashed Compaq Portable knockoff that stumbled along for two years before being replaced in 1986 by the PC Convertible laptop. The Convertible—an under-powered T1100-like machine that required you to clip bulky, extra-cost expansion slices to the machine's backside if you

wanted to drive a video monitor or connect up with a printer or mouse—provided a healthy measure of comic relief for the industry. Last year, IBM finally got it right with the portable P70.

Today, five companies account for four out of every five portable-computer sales. According to IDC, the leaders are Zenith with 24 percent, Toshiba with 21 percent, Compaq with 12 percent, NEC with 9 percent, and Tandy/GRiD with 8 percent. Other major players include Sharp, Epson, Sanyo, and IBM.

WHAT'S IN A NAME

Laptop, portable, transportable—what do all the terms mean? Understanding which term means what may help frame your discussions. For the purposes of this issue, we consider a *laptop* to be a portable PC that has batteries and fits comfortably on your lap. It should weigh no more than 10 to 12 pounds, but the

weight ceiling isn't absolute—you can balance 15-pound units on your lap, too. Traditionally, laptops have had 8088 or 8086 processors; now many of them have 286 processors, such as Compaq's svelte 7-pound LTE/286.

A *portable* is a laptop's husky big brother, still battery-powered (usually), and weighing 12 to 17 pounds. Sometimes it's called a "true portable" to distinguish it from AC-only units such as the Mitsubishi MP 286L. If a machine weighs even more, 20 to 25 pounds, and lacks battery power, it's a *transportable*, such as the Compaq Portable 386 and Portable III. If you can't figure out which term to use, just say *portable*. Using the wrong term is a minor *faux pas* on the order of eating your salad with a dinner fork; it's not a capital crime like mistaking your finger bowl for a water glass.

Less formally codified definitions include *luggable* (over 25 pounds), such as the original Compaq Portable; *handheld*, *pocket*, or possibly *palmtop* (just that, and not necessarily a DOS machine) such as the Poqet PC or Atari Portfolio; *pocket organizer* or *electronic Daytimer/Filofax* (a smart calculator with an alphanumeric keypad and the ability to store notes, dates, and phone numbers—definitely not a DOS machine), such as the Casio BOSS or Sharp Wizard (hint: look for a QWERTY

rather than an alphabetically arranged keypad); and *DOS companions* or *DOS work-alongs* (non-DOS laptops, typically under 5 pounds, that can share text-editor files with PCs). Terms evolve as products evolve.

The *notebook* portable is a case in point. The term used to mean Tandy's non-DOS portables, such as the 100 and the 200, favored by traveling writers and editors. But the DOS world has co-opted that term to mean the lightest of the DOS-based laptops, those that weigh under 8 pounds: the Compaq LTE and LTE/286, the NEC UltraLite, the Tandy 1100 FD, the Toshiba T1000, the Toshiba T1000SE, and the Zenith MinisPort.

Then there are terms to describe the configuration: *clamshell* for a laptop machine where the display screen hinges up, and *lunchbox* for the chunky, upright Compaq Portable III and its brethren where the keyboard unfolds from the front and the screen swings out slightly. Terms that haven't caught on include *sandwich* or *clamshell sandwich* to describe the Compaq SLT/286 clamshell whose keyboard pulls out, much like the meat in the middle of a sandwich, and *sewing machine*, a pejorative term describing the heft of the earliest portables.

CHOOSING THE RIGHT PORTABLE

There is no one *right* choice among portables. The right machine depends on the tasks you have planned for it. That said, let's consider some of the most important features you should expect on your next portable, especially if it's the only PC you've got.

Processor. Don't settle for anything less than a 386SX machine if this is to be your only machine. We've said that about desktop PCs for the past year, and by the end of this year, that same rule should apply to portables as well. By year's end, almost everyone who produces 286 portables should have SX versions on the market. While the SX is by design a low-power (CMOS) microprocessor, there's an even lower-power version due shortly, along with a 20-MHz SX. Some vendors, such as Compaq, are waiting for the lower-power SX chips.

Display. You'll also want a VGA display (640- by 480-line resolution), not EGA (640 by 350), and certainly not CGA (320 by 200). While the difference between VGA and CGA on an 8- by 6-inch screen isn't all that noticeable, it is when you hook up an external color monitor at

PRINTERS TO GO

by Mary Kathleen Flynn

If your idea of a laptop's best friend is a portable printer, you're in luck. Although the market isn't exactly overflowing with portable printers, there are two that should satisfy your on-the-road output needs.

Your best bet for an under-6-pound battery-operated printer is the Kodak Diconix 150 Plus, which won Editor's Choice in our November 14, 1989 special issue on printers. At \$499 for a parallel version and \$519 for a serial version (not including the five C-sized nickel cadmium batteries), the ink jet 150 Plus costs and weighs roughly the same as the 9-pin dot matrix Axonix LiteWrite and the thermal transfer Toshiba ExpressWriter 301, but prints about twice as quickly. The Toshiba 301 produces slightly better print quality

than the 150 Plus, but at present it's just too slow.

For printing multipart forms on the road, Toshiba's \$589 ExpressWriter 311 can't be beat. At 11 pounds, the battery-less 24-pin dot matrix is no featherweight, but it is smaller and lighter than the average 9-pin dot matrix printer. And you can't get comparable speed, print quality, or paper handling from any of its truly portable cousins.

For full reviews of the Axonix LiteWrite, the Kodak Diconix 150 Plus, the Toshiba ExpressWriter 301, and the Toshiba ExpressWriter 311, see the November 14, 1989 issue of *PC Magazine*. For a complete review of Hewlett-Packard's \$495 ThinkJet printer, see the November 27, 1984, issue of *PC Magazine*. ■

your desktop, as you will if your portable has a home base. Most portables have the ability to output a color signal to a color monitor even though the portable itself, of course, has a noncolor display.

Some portables—like the Toshiba T3100SX—let you keep both displays active; that's helpful if you intend to use your

battery life to about a pound of battery. Battery-powered portables typically have backlit or sidelit liquid crystal displays (LCDs). AC-only machines have backlit LCDs, electroluminescent displays (the least commonly used technology), or more-power-hungry gas plasma displays. Don't get too hung up on the technology and the jargon: supertwist, active matrix, and cold fluorescent screens aren't options that you can specify or delete like whitewall tires. You get exactly what the vendor sells you.

As important as screen type are screen size (the best ones are 8 by 6 inches or bigger) and the ability to render color as distinct shades of gray. Watch out for displays that fall well outside the desktop standard aspect ratio of 4:3, or 4 inches wide for every 3 inches tall.

Hard disk. No serious portable should be without a hard disk. Last year, your choices were typically 10 or 20 megabytes and maybe 40MB. Now it's 20, 40, or 100—just like the options on a desktop PC. If you're torn between 20 or 40MB, pay the extra \$500 for the bigger drive. You won't regret it. It's just like buying your first house—no one ever complained about buying a house that's a little too big. Hard disks on 8088/8086 machines are problematic: the hard disk provides per-

The "right" portable
for you depends
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portable as a demo machine, as you can sit off to the side and let your audience gather around the external display. Some of the smallest laptops (NEC UltraLite, Toshiba T1000SE) stick with CGA displays and omit the external-video connector in order to keep the system simpler and cheaper.

Virtually all portable PCs have illuminated screens. That limits battery life to 2 to 3 hours for most machines, using a rough rule of thumb that allots an hour of

Put six *PC Magazine* editors in a room with the best portables you can find, and you'll come away convinced once and for all that there's no such beast as the "right" portable. From editor-in-chief Bill Machrone, whose constant companion is the NEC UltraLite, to assistant editor Matt Ross, who has scrutinized hundreds of PCs while managing our computer stories for the last year, we've each got our own favorites—and our own least favorite portables. As you decide which portable is right for you, consider our experiences and opinions.

Bill Machrone, editor-in-chief and publishing director:

The Toshiba T1000SE is my pick as the best all-around notebook computer. Lots of people want and need the floppy, and Toshiba was thoughtful enough to use a 1.44MB drive. The screen is very readable, has a wide viewing angle, and I like the separate brightness and contrast controls. The 2MB RAMdisk card is a terrific feature that gives better-than-hard disk performance, albeit at lower storage. The only things I don't like about the 1000SE are Toshiba's unremittingly ugly screen font and the too-high keyboard effort.

People who complain about the Poqet PC remind me of the story about the singing dog. In criticizing the nuances of inflection, they overlook the amazing feat that it's singing at all. The keyboard is doubtless the Poqet's biggest weakness, but it pales beside the basic accomplishment of so completely miniaturizing a full DOS machine. No one will ever touch-type on the Poqet's existing keyboard, but I don't think size is the obstacle. Ergonomics more like the Atari Portfolio's would do the trick. The Poqet is no substitute for a briefcase machine, but it's ideal for the growing numbers of people who need facts and computation at their fingertips.

The NEC UltraLite is the machine I use every day, and I wouldn't trade it for any other notebook or laptop machine. Having no floppy disk makes it idiosyncratic to some; a joy to me. Already the lightest machine with a full-size keyboard, the UltraLite has lost 10

percent of its original 4.4-pound weight since its introduction. For that, the brighter screen, and the easily replaceable batteries, I am grateful indeed. It is, however, a bit more than a year old and needs some updating. Automatic power-down and resume is a requirement for machines in this class. The ROM could be put to better use than

solely on experience with a desktop, the NEC ProSpeed 286 could be your best bet. The ProSpeed's VGA screen is sharp, shows 16 shades of gray, and has a generous, full-travel keyboard with great feel. Its proprietary LTX slot opens up the worlds of networking, high-speed modems, etc.

I liked the Epson Equity LT-286e machine more than I expected to. It has a generously large screen and good quality throughout. The removable

If you could have only one computer, or if all your perceptions are based solely on experience with a desktop model, the NEC ProSpeed 286 could be your best bet.

harboring Microsoft's DOS Manager shell, and the machine should have a standard 9-pin RS-232 port. I love the 2400-bit-per-second modem, but I wish it supported MNP. The setup program could do more. But I do love the UltraLite.

The Compaq LTE and LTE/286 are surprisingly low-tech for Compaq products. The machines are built by Citizen for Compaq—and some say they were designed there, too. My biggest complaints are about the keyboard and Compaq's retreat from VGA, which Compaq said was essential for its SLT/286. The keyboard has too many keys nearly the same size or color. Some of them do as many as three different things, and the keytops are cluttered with labels and legends. The L-shaped cursor key layout is not the worst I've seen, but is a poor substitute for the industry-standard inverted T. The keyboard is noisy, too, and feels uncharacteristically cheap for a Compaq product. Still, the 286 version is remarkably complete, if somewhat pricey, for a 7.2-pound, 40MB machine.

In the Fall of 1988 I saw the prototypes of the NEC UltraLite and the Zenith MinisPort. I was elated that there would be real competition in the then-emergent notebook arena. Boy, was I wrong.

If you could have only one computer, or if all your perceptions are based

hard disk is innovative and may even be useful. It certainly makes the upgrade from dual-floppy easy. The LCD status panel is snazzy, if superfluous. I really like the 16-bit ISA slot under the keyboard, however. Its three-quarters length is sufficient for most purposes; moreover, the overall machine is not significantly bigger than the ProSpeed 286, and they weigh the same. I like the way everything slides and clicks, clunks and thunks, but most of the springs are too stiff. The keyboard is a bit perplexing, with a somewhat random layout. It's especially hampered by the small Backspace key. If I were redesigning this machine, I'd start with the keyboard. And I might just stop there.

Bill Howard, executive editor:

For running low-end integrated software like *Microsoft Works*, and as an on-the-road e-mail fetcher, the Toshiba T1000SE is unsurpassed. With a big screen, quick-change batteries, and the single high-density floppy, it's light years ahead of the T1000 it evolved from. Both the Zenith MinisPort and the T1000SE weigh 6 pounds, but the compromises that Zenith made to reach 6 pounds are killing the MinisPort: a nonstandard 2-inch floppy and a tiny gunslit of a screen. Tandy's 1100 FD was designed to knock off the original T1000, but technology is a moving target. Despite the nonilluminated screen

and no memory expansion beyond the stock 640K, the 1100 FD's price (\$999 list) is right, and you'll appreciate DOS and *DeskMate* in ROM.

However, there's still nothing like the 4-pound NEC *UltraLite*. Lack of a floppy disk (you get 1 or 2MB of "silicon disk"—buy the 2MB version) keeps this a niche product. This is the machine I use every day while commuting; the productivity gains I've experienced have quickly returned its \$2,000 (current street) price. I may be in the minority, but I don't see palmtops taking off any time soon. Either they do too little (Atari) or they cost too much (Poqet). Either way, you can barely read the screens.

The Compaq *LTE/286* stands alone if you need 286 power in a tiny (8.5- by 11-inch) 7-pound box. Be aware of its two compromises: tiny function/cursor keys, and a smallish 8-by 4-inch, CGA-only screen. The 8086 *LTE* variant makes less sense: if you're buying a hard disk, you should be buying a 286 or 386SX.

Among the 15-pound battery-powered 286 portables, you should go for the biggest, brightest screen. The best battery-powered 286 portable you can buy is the Toshiba *3100SX* with the 8- by 6-inch gas plasma screen. Yes, I know it has a 386SX chip; you should treat the SX as the thinking man's 286. Take a look at the equally new Dell *386SX*; it's priced right. I also like NEC's *ProSpeed 286* with the 16-MHz 286; big screen, bulky box. With its removable keyboard and intelligent power management, the Compaq *SLT* may be the best all-round 286—certainly the best of the 286/12s. The 12-MHz Toshiba *T1600/40* is OK but hampered by short battery life and an EGA (not VGA) display; Sharp's 12-MHz *PC-5541* is a bit bulkier and the VGA screen is easy to read, but color mapping isn't so hot. You should read Catherine Miller's sidebar on color mapping (translating color to shades of gray); the issue doesn't get enough attention.

Among the no-holds-barred 386/20 and 386/25 AC-only transportables, my favorites are Toshiba's *T5200*, IBM's *P70*, and the 25-MHz Dolch. I particularly like IBM's separate numer-

ic and cursor keypads, the 9- by 6-inch Toshiba display, and the speed of the Dolch. Compaq pioneered this market, but the 20-MHz Portable 386 is way behind the times.

I haven't said much about keyboard quality (you'll read plenty elsewhere) because you'll get used to just about any keyboard. One-sentence summary of portable PCs: If you're charged with creating a corporate portables pool, buy *T1000SEs* and give them out like party favors; get *UltraLites* for key executives; make Toshiba *3100SXs* your mainstay DOS-to-travel boxes; and buy the *T5200* and *P70* (plus external VGA monitors) as desktop machines for your staff who're also on the road a lot.

Gus Venditto, executive editor:

Over the years, Compaq has perfected a lot of IBM's ideas, but one subject it has failed to master is keyboard design. The Compaq *SLT*, *LTE/286*, and *LTE* demonstrate an incredible engineering tour de force with a very big exception: the clumsy keyboard. Why's the Fn key bigger than Ctrl and Alt? Why a lop-sided L alignment for the four cursor keys instead of a diamond? The *SLT* and *LTE* remind me of a championship boxer: muscular with lightning reflexes. But the interface is, well, obtuse.

Zenith's experience in building top-notch laptops shows in the *MinisPort*'s keyboard, but in virtually no other aspect. Its screen is dim, its disks non-standard, and its weight surprisingly heavy for such a compact package.

If you need to carry around a powerful machine and want to get the most from your money, the *T3100SX* is a terrific choice. All the right decisions were made when this was on the drawing board.

If nothing else, the Poqet PC proves that it is possible to make a computer too small. The world now knows that an IBM Model 360 is the upper limit on how large a PC should be, and the Poqet PC clearly stakes out the lowest extreme.

Why should you bother struggling with the weight and size of the NEC *ProSpeed386*? Why not lug around a desktop system and be done with it?

CONTINUES

formance out of proportion to what the CPU offers. If you need a hard disk, why aren't you shopping for a 286 or 386SX? Conversely, it's almost impossible to buy a 286 portable with only floppy disk drives.

Floppy disk. Make sure your portable's floppy disk drive has a high-density 1.44MB capacity. That's assured if you buy 286 or 386 portables but a rarity on 8088/8086 portables. Toshiba wisely chose the 1.44 for its 8086-based, single-drive *T1000SE*, as did Compaq with its *LTE* and *LTE/286*. You'll encounter a 2-inch, 720K floppy in Zenith's quirky *MinisPort*. It's the same size as, but not interchangeable with, the disks in electronic cameras.

Zenith said it needed the 2-inch drive to make a laptop weigh less than 6 pounds. Six months later, Toshiba proved that wasn't the case. So far, the 2-inch floppy disk drive appears to be a nonstandard standard.

Keyboard. Unless you build an ultrawide portable such as IBM's *P70*, you can't provide a 101-key keyboard with three separate alphanumeric, numeric, and cursor keypads. On most transportables, especially lunchboxes, you may find a sin-

As important as
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shades of gray.

gle numeric/cursor keypad (you toggle between the two), as on the Compaq Portable III, Portable 386, and Toshiba *T5200*. On portables, the best you can hope for is that you get eight dedicated cursor-movement keys, rather than four keys that do double duty with a function key. Most of the 286 and SX portables that lack separate numeric/cursor keypads provide a jack that lets you plug in an external 101-key keyboard (about \$100 to \$150).

All Toshiba portables and laptops provide eight cursor keys, as do the larger NEC portables; Compaq and Zenith give

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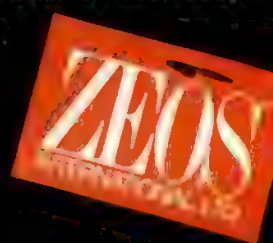
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you only four. Many laptops and portables have function and cursor keys that are smaller than normal. Just make sure they don't squeeze the size of the QWERTY keys, too. Take a ruler and measure the distance from the left side of the Q key to the left side of the [(left bracket) key; those ten keys should measure 7.5 inches. Make sure you can live with the placement of all the specialty keys. A few vendors (Chicony for Data World, for example) do silly things like break the function keys into two rows.

Connectivity. Most portables have space for an internal modem. If you do get a modem, your best buy is a 2,400-bit-per-second modem or a 2,400-bps modem with MNP, the error-correction protocol that's most widely used by businesses and dial-up services. A 1,200-bps modem

begs the question: How much is your time worth? Some portables have added proprietary expansion slots, most notably NEC with the LTX slot in its ProSpeed 286 and ProSpeed 386. In them you can put a modem, fax card, or a network adapter. Most commonly, vendors will offer Ethernet, Token Ring and ArcNet network cards; you can get them from third parties as well. Some of the bulkier clamshell portables provide room for one or two AT-style expansion cards, as do virtually all of the lunchbox portables except the Compaq Portable III and Portable 386, which require \$200 expansion bustles.

Expansion. Many vendors sell expansion units or docking stations with room for additional hard disks, tape drives, a

5.25-inch floppy, and expansion cards. But if you have got a big hard disk, a VGA card, a modem, and a network connector inside your portable, why do you need this \$500 to \$1,200 box? The only ones that make sense are the one-step, click-and-lock base units that automatically connect the cables and cords you'd have to laboriously connect and tighten manually. Most expansion units aren't this sophisticated: Compaq, Dynabook, and NEC are among the vendors who offer such units for some machines. And most of the lunchbox units have at least one expansion slot, including the Dolch portables and some of the knockoffs of the Compaq Portable III/Portable 386.

FCC approval. Computers come in two flavors, according to the Federal Communications Commission: Class A, for of-

COUNTERPOINTS

CONTINUED

Jonathan Matzkin,
associate editor:

The Compaq LTE/286 is about as close as I've seen to an ideal laptop. It offers an excellent backlit CGA screen, 40MB of storage, and a 286 processor. In other words, most of the comforts of home in a very small package. I can't think of another briefcase-size machine that has as much to offer. The only drawbacks are the screen resolution, which could (should!) be at least EGA, and the keyboard layout, which is strange and cumbersome to say the least.

No one takes the Atari Portfolio seriously, but here goes! For \$399, you get a competent notetaker, a limited but useful spreadsheet, and communications capability. The simple-to-use file transfer utility (requires optional parallel port) makes it easy to exchange ASCII and .WKS files with desktop machines. When Atari comes up with comm software, the Portfolio will be worth its price simply as an e-mail terminal that you can literally take anywhere. It's not a DOS machine, but the Portfolio is a legitimate computer and has the potential to serve two useful roles: as a portable data container for DOS users who can't justify a laptop, and as the only computer for professionals who would benefit from a com-

puter but won't invest the time, money, and effort it takes to learn a full-fledged machine. Anyone currently bopping down Madison Avenue clutching a Casio B.O.S.S. or Sharp Wizard ought to take a look at the Portfolio; it stands head and shoulders above either of those machines.

Robert W. Kane,
PC Labs project leader:

After 18 months on the market, the class of the battery-powered field remains the Compaq SLT/286. I love

PC'' than a portable.

If you just can't stand the weight, the Compaq LTE/286 might be your cup of tea. Performance wise, it's the same as the SLT. But the CGA screen (not even double-scan CGA for text), and the cramped keyboard—which has an impossible cursor key layout—may be too much of a compromise for applications that demand the LTE's power.

In the light laptop arena, the Toshiba T1000SE is the new standard bearer. The improved screen, remove-

The Compaq LTE/286 is about as close as I've seen to an ideal laptop. It offers an excellent backlit CGA screen, 40MB of storage, and a 286 processor—most of the comforts of home in a very small package.

the screen, the detachable keyboard (the best Compaq keyboard ever), the speed of the display, the 40MB hard disk option, and the battery life. For those who say it's too heavy: eat your Wheaties! If I can get desktop functionality in 14 pounds, I'll live with shoulder strain.

While the NEC ProSpeed 286 clocks faster than the Compaq SLT (16 vs. 12 MHz), its ponderous size, less readable screen, and crushing weight (nearly 20 pounds with the large battery slice) makes it more of a "modular

able battery pack, 1.44MB floppy disk drive, and removable RAM cards all build on the strengths of the original T1000: functionality and usability in a 6.5-pound package. The only complaint I have is the screen's inability to pivot a complete 180 degrees.

There's no denying the technology and innovation in the NEC UltraLite. But I'll never risk my important data to anything other than removable magnetic media. With the 3.5-inch drive and transformer in tote, the UltraLite becomes a tangle of cords and devices that

fice use only; and Class B, suitable for use in the office or home. Class B machines are designed to cause less interference with other electronic devices. Because portables are, well, portable, the FCC now says it will offer only Class B certification for portables. The only exception will be for *highly* specialized portables, such as handheld inventory-recorders. Machines described in our reviews as Class A (or Class B pending) are typically new units and are currently undergoing FCC certification. "Class B pending," by the way, is a term implying hopefulness on the vendor's part, not an FCC designation.

Also expect to see trouble brewing for mail-order vendors of Class A desktop PCs. The FCC may ask the vendors for proof the machines are being sold to business, not home-based, users. Even if you

can buy Class A, you should go for Class B because it takes smarter engineering and tighter quality control to achieve Class B. In other words, you're looking for exactly the same thing as the FCC.

MARGINAL DIFFERENCES

You want the smallest, fastest portable that your money can buy. But don't get hung up on relatively minor differences. For the most part, machine specifications that fall within a third of another machine's range in such factors as size, weight, performance should be considered similar. And one machine's advantage may be offset by a disadvantage.

Suppose, for instance, you narrow your choices to the Sharp PC-5541 and the To-

shiba T1600, a pair of 286/12s with 40MB hard disks that are among the better 286 portables. The Sharp is 12 percent faster at running the PC Labs Instruction Mix test (the most important benchmark test), but it's also an inch longer and half an inch thicker. Toshiba does a better job of mapping colors to gray shades, but the Sharp has a VGA display, while the Toshiba has an EGA. And they weigh the same. The

is beat by the streamlined T1000SE in both weight and price.

Two other machines that have created quite a stir are the **Poqet PC** and the **Atari Portfolio**. Unfortunately for DOS users, both machines come up a bit short: Atari with its DOS "compatible" operating system and limited memory options, and the Poqet, which suffers from fit and finish problems. If someone would make a machine with the Poqet's functionality, the workmanship of the Portfolio, and a price that splits the difference between the two of them—say about \$1,200—I'd buy it in a minute.

Matt Ross, assistant editor:

The **Compaq LTE/286** is a machine that simply doesn't fit into any category well, but this is the fault of the categories. It is the first Super Notebook machine. Its bright display, standard removable media (which leaves the **Zenith MinisPort** and its 2-inch floppy dead in the water), and a 40MB hard disk all in a notebook form factor make this the best notebook currently available. I'll suffer the extra pound or two for a 286 with 40 megabytes of storage. Unfortunately, Compaq's keyboard and the icons for the serial, parallel, and keyboard ports couldn't be more confusing; also, this machine should drive its LCD and an external monitor simultaneously. However, for my money, the Compaq LTE/286 is the best small portable currently available.

As far as the other notebooks are

concerned, I would opt for the **NEC UltraLite** or the **Toshiba T1000SE** over the 8086 version of the **Compaq LTE**. If you need a hard disk, chances are you need a 286 as well. The 4.4-pound NEC UltraLite is hard to beat when you consider its size and weight. Its display is bright and clear, but the T1000SE's is also good and has a better aspect ratio. Toshiba wins on its alarm indicating that the unit is still on, a better keyboard, and its 3.5-inch high-density floppy. But NEC offers a built-in 2,400-bps modem. If we could somehow merge them into something that is about 5 pounds—well, maybe next year. The **Poqet PC** may fit in your pocket, but the keyboard is unusable, and the display isn't much better.

The best displays are found on the **Toshiba T3200SX** and the very similar **T5200**, and **IBM's PS/2 Model P70**. All three feature VGA gas plasma displays that are larger than 10 inches in diagonal and have a good gray scale. In the 286 market, the **Compaq SLT** and the **Sharp 4551** have the best supertwist LCDs. Both support VGA. The color LCD on the **NEC ProSpeed CSX** is a technological breakthrough, but it remains too inconsistent to be worth the investment.

At the 386 end of the market, the **T3100SX** is the most interesting of the lot. The first VGA gas plasma SX driven by batteries, it not only gives you great video and 3 hours of battery life, but weighs less than 15 pounds. ■

Little features make some portables vastly more desirable than others, such as save-and-resume, intelligent power management, and color-mapping utilities.

purpose of our reviews is to highlight each machine's special advantages and disadvantages. Ultimately you'll choose on the basis of which features are most important to you.

BELLS AND WHISTLES

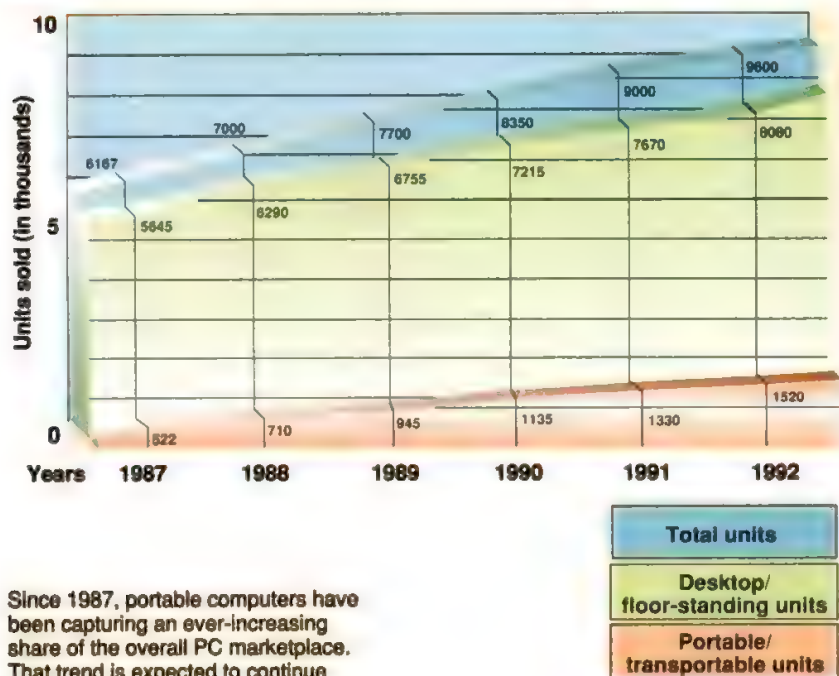
Little features make some portables vastly more desirable. They include save-and-resume (the machine goes into a power-saving trance for 10 minutes or 10 days; power up and you're back where you left off), intelligent power management (the hard disk and backlight turn off if they're not used for several minutes), and color-mapping utilities.

If you fly coach class frequently, look for a center-hinged screen on your portable; rear-hinged displays get scrunched when the guy in front slides his seat back. You should expect the vendor to include a separate, brief "Road Warrior" pamphlet that lists the basics of operation. It's silly to have to carry a 2-pound manual just to look up the three-key sequence to invoke the external display or setup.

If you travel overseas, look for 120/240-volt operation (some transform-



CATCHING UP TO THE DESKTOP



Since 1987, portable computers have been capturing an ever-increasing share of the overall PC marketplace. That trend is expected to continue into the early '90s.

Source: International Data Corp.

ers will work on 240 volts even if it isn't marked—ask the vendor). You'll also appreciate models that have quick-change batteries or use other tricks to make changing batteries easier. Toshiba gives you dual battery trays so that you can replace one at a time; the Dell 386SX actually holds its breath (and data) for 3 to 5 minutes while you change its single battery. Removable batteries also let you save from 1 to 5 pounds if you know you'll be using only AC power while traveling. A 12-volt converter comes in handy if you want to work in a car.

Most vendors offer external 5.25-inch floppy disk drives. Buy one if you want. However, most of them are big, expensive, and ungainly. You're better off sticking a 3.5-inch drive into your desktop PC for \$150 or learning to use a \$100 data transfer program such as *Lap-Link*, *Desk-Link*, *Brooklyn Bridge*, or *Fastwire II*. All of them work well.

Check the size of the battery charger/AC transformer. Some are behemoths (Epson, Dell), while others are compact (Tandy 1100FD). If you're traveling frequently between two locations, especially by air, consider buying two sets of char-

gers, batteries, and adapter cables and keep one set in each location. That can save you 2 to 4 pounds of carry-on weight.

**Some transformers
will work on 240
volts even if it isn't
specifically marked.
Check with the vendor
to find out for sure.**

Some companies now make portable recharging stands that recharge several batteries at a time; others have quick-charge batteries that need only 2 to 3 hours instead of all night.

FUTURE PORTABLES

It doesn't take a crystal ball to guess what's up for portables. You'll see more power in

smaller packages. By the end of 1990, the mainstream will probably be a 10- to 12-pound 386SX portable with a VGA display and a 40MB hard disk. Expect to see some SX machines break the 10-pound weight barrier.

You'll see the smaller portables shift from 3.5-inch hard disk drives that weigh about 1 or 2 pounds to 2.5-inch drives that weigh under 10 ounces (less than some floppy disk drives), and use about 2 or 3 watts of power. They're from (now or shortly) PrairieTek, Rodime, Conner Peripherals, MiniScribe, and JVC. Current 2.5-inch-drive technology accommodates 20 and 40MB of storage; you can expect to see 100 to 200MB storage capacity in the future.

When it comes to communications, you'll see more modem/fax card combos—NEC's should be shipping by the time you read this. Of course, PC fax still works better as an outbound tool. On higher-end portables, the 2.4-kilobit-per-second modem standard will eventually evolve to a 9.6-kbps V.42bis modem that, with data compression, can attain as much as 38.4 kbps throughput.

Color portables that you'll want should arrive at year end. The current offerings from NEC and Sharp are adequate, but you'll be dazzled by what you can buy six months to a year from now. Expect to pay a stiff premium—about \$2,000—to get color.

One breakthrough we're unlikely to see is a magical power supply that doubles or quadruples battery life. Virtually all the advances in power consumption have come from making portables draw less power—not from increasing the power supply.

CAVEAT EMPTOR

No one is out to cheat you, but keep your eyes open. Make sure that the price you're quoted for a portable is for a machine you can use. NEC, for instance, doesn't include a battery with its 286 and 386 Pro-Speeds (add \$200); and since the battery is not included in the base price, some of NEC's advertising compares the Pro-Speed's weight without a battery to the competition's weight with a battery. Nice try, folks. If the machine uses two batteries, find out if none, one, or both are included. In these reviews you'll find two or three prices: one for the vendor's base price, one for what we consider a standard configuration (unless it's the same as the base price), and one for the tested system.

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Similarly, ask the vendor if the battery is a slice that fits on the model's back (Zenith SupersPort) and whether that slice is included in the advertised size and weight. PC Labs weighs every machine it receives—with the batteries included—for *PC Magazine's* features tables.

One 8088 laptop vendor previously didn't include the LCD display in the base price since it gave you a choice of two displays, reflective or backlit. Many vendors don't include MS-DOS (about \$100) in the base price.

Another important accessory, a carry-

The trend is toward more power in smaller packages. By the end of 1990, the mainstream will probably be a 10- to 12-pound 386SX portable with a VGA display and a 40MB hard disk.

ing case (\$50 to \$300), is almost always extra. If the vendor offers several, it makes more sense to opt for the biggest case so that you can include the papers you'd normally carry in your briefcase. (If you plan to use your portable on airplanes, don't forget that you're allowed to carry on only two pieces of luggage.)

You also should pay close attention to the discussion of fit and finish in the reviews. Generally speaking, PC Labs found the greatest quality problems with some of the lunchbox portables that stuff components of varying quality inside a shell constructed to look like Compaq's Portable III/Portable 386, and more recently like the Compaq SLT/286. In some cases, access to the expansion slots may be obstructed and you might not be able to use them.

So far, *PC Magazine* reviewers have discovered that it's much easier for lesser-

known vendors to build good desktop clones than portable clones. For this reason, good compatibles can be had from mail-order manufacturers; the Dell 316LT is the best example.

ISSUE ORGANIZATION

In this issue, we review every important PC-compatible portable you can buy as of early 1990. They're arranged in sections by processor type: 386 and 386SX; 286; then 8088/8086 notebook or laptop PCs, but only battery-operated ones weighing about 8 pounds or less. Each section—386 and SX, 286, 8088/8086 notebooks—has its own introduction, features tables and benchmark tests, and Editors' Choice box.

We've chosen not to review heavier 8088/8086 portables because it's a dead market. If you're going to lug around a 12-pound laptop portable, you deserve more than what these boat anchors give you. The heavier designs from Zenith, Toshiba, and NEC are all two years old or more by now; industry wisdom has it that there are no plans to replace them. Buy a Zenith Z-184 (16 pounds) or NEC MultiSpeed HD (15 pounds) only if you get an exceptionally good deal on one. With two floppy disk drives, you should expect to pay under \$1,500; with one floppy disk drive and a 20MB hard disk, under \$2,000.

To make it into this issue, a working unit had to arrive at PC Labs by November, 1989. A few vendors declined to send us some models. Of these, the most notable was KISS, which chose to submit its 286 but not its 386 for this roundup. In some instances, as in the case of Mitsuba's 386 portable, a working unit didn't arrive in time for us to review it, although the company did send us its 286 model, the Ninja-12 VGA.

We also discuss pocket-size DOS-workalong computers (see the sidebar "Palmtops"), portable printers (see the sidebar "Printers to Go"), the hassles of mapping color images to your portable's noncolor display (an important and underappreciated issue; see the sidebar "VGA Portable Displays"), and the Macintosh portable (see the sidebar "The Traveling Macintosh").

Counterpoints, a *PC Magazine* tradition for portables reviews, culls additional thoughts on a half-dozen major portables from editor-in-chief and publishing director Bill Machrone, executive editors Gus Venditto and me, associate editor Jonathan

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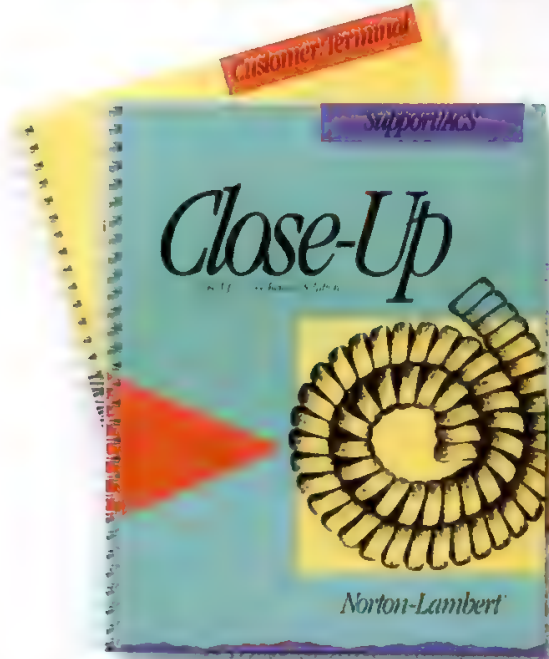
Jennifer Zaino is a staff editor of *PC Magazine*. ■

Matzkin, assistant editor Matt Ross, and PC Labs project leader Robert W. Kane (see "Counterpoints").

Somewhere on these pages, you'll likely find your next PC lurking. This time, it's going to be portable. ■

"Leader of the Pack"

— PC Magazine, October 31, 1989



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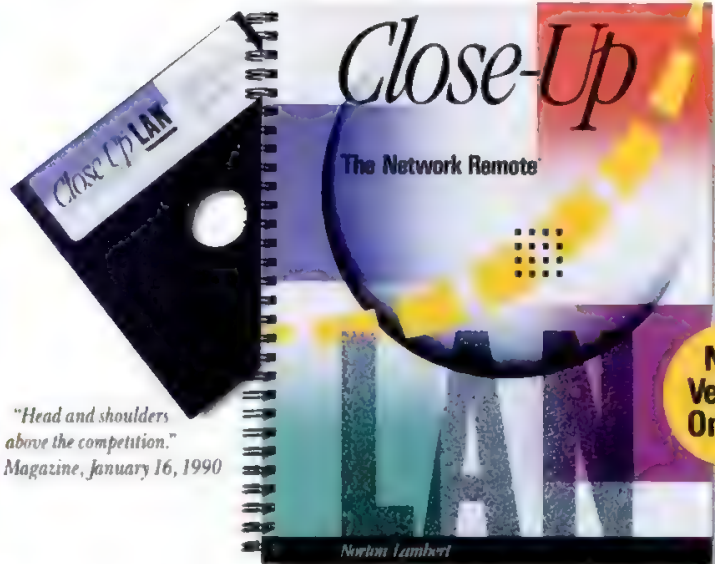


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ut others will
your desktop
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PORTABLES AND TRANSPORTABLES

by Mitt Jones

It's tempting to begin this section with an all-out condemnation of the class of 386 portables as a whole. After spending weeks in PC Labs dissecting the best and worst the market has to offer, one remembers primarily the worst: a lot of off-brand, bargain-priced lunchbox models that seemed to challenge us simply to keep them running. Weight typically runs in the neighborhood of 20 pounds, and prevailing wisdom seems to dictate stuffing as many full-size desktop components as possible into a somewhat downsized box with a handle.

With the popularity of the 386 and 386SX portables on the rise, however, a precious few vendors finally seem to have turned their attention to engineering a new class of 386 portables.

Toshiba, for one, has made admirable progress in reducing the 386 form factor, most notably with its clamshell-design T5100 and T3100SX.

Neither machine is perfect, but both make strides toward reducing the muscle aches that often accompany a 386 portable.

IBM, too, has been busy in the past year. Though its PS/2 Model P70 386 weighs over 20 pounds, the lunchbox chassis measures much thinner than most, making it easier freight than much of the competition. The machine's excellent screen, expandability, and OS/2 agreeability also weigh strongly in its favor, especially for use as a travel-ready, desktop-replacing machine.

These few machines aren't the only good choices among the machines reviewed here. Rather, what is true for desktop machines holds doubly true for portables: which machine you choose should depend on your particular needs and budget. No one machine even comes close to being the universal best choice.

PORTABLE CLONES

Just as the IBM XT and AT sparked hundreds of clones—machines that imitated the exact form factor of the real thing—the Compaq Portable 386 appears to have inspired many copycat machines from vendors such as Data World, Micro Express, Micro Telesis, National Micro Systems, Pan United, PC Brand, and Tangent. Low-cost vendors wishing to market such clones need only buy the chassis from Chicony or another vendor and customize the internals to their liking, if at all.

A beneficial result of this practice is that you can now buy off-brand machines comparable with Compaq's paradigm for half the price or less. If you like the idea of buying a portable as your primary machine, whether for the advantages in portability or simply for the desktop-saving size, you're sure to find at least one in the bunch that fits both your needs and your budget.

The downside, of course, is that you can get stuck with a nice-looking hunk of trash if you buy by looks alone. For all their similarities in styling and form factor, the Compaq clones and the rest of the 386 portable offerings differ widely in the features they offer and in the quality of those features.

One of the most visible and important differences lies in the display. All of the machines reviewed here boast an illuminated display—a gas plasma or supertwist LCD. While the great majority of them are easy to read in text mode, display quality varies considerably once you begin working with graphics.

Part of the difference results purely

from the number of gray scales the video subsystem is capable of generating—typically 4, 8, or 16—and the resolution and graphics standard supported—CGA, EGA, or VGA. A few machines, such as the 16-shade IBM PS/2 Model 70, go beyond their published gray-scale level by using dithering to simulate additional shades. In addition, the mapping of colors to gray scales can vary from vendor to vendor and yields considerably different results. For more on color mapping, see the sidebar "VGA Portable Displays: It's All in the Color Mapping" in the 286 section.

Most of these machines come with a standard external monitor port for times when only true color will do, but here again you'll find substantial differences. A small handful will drive an external VGA monitor; most support only EGA or CGA. While most of the machines force you to use only the integrated display or external monitor at any one time, a few, like the Toshiba T3100SX, support simultaneous display—a real boon if you'll be using the machine to demonstrate software or give other computer-based presentations.

Keyboard quality should also weigh heavily in determining which machine you should buy, even more so than with a desktop system. While most of the systems reviewed here allow connection to standard, full-size keyboards, you'll be chained to the portable's keyboard when you're out of town.

With few exceptions, our reviewers liked the feel of the keyboards on these machines. Keyboard layout, however, varied widely, ranging from the perfect, 101-style model of IBM's PS/2 Model P70 to the convoluted, downsized keyboard of the GRiDCase 1530. Look carefully at the system photographs and read the reviews carefully: one vendor's offbeat layout may be perfect for the applications you have in mind; another's might cause you unending frustration.

EXPANSION

Once past the more-visible aspects of these machines, you'll also find drastic differences in expandability and available options from system to system. Most 386 portables can now accommodate fast, 100MB hard disks and at least 8MB of RAM, but availability of expansion slots is not such a sure thing.

While some companies may boast that

their lunchbox 386 has five or six expansion slots, one quickly learns upon dismantling a few machines that most of the slots are already filled by standard-equipment add-ons. Even the largest lunchbox units often leave either no slots or one slot free for others. Especially if you're planning to use your portable as your primary machine, the features table for machines that offer an extra few slots open or that docking station expansion chassis or Some vendor option.

er Systems and as Dolch Computer Systems Corp., option you could yering nearly any nal, external, or via s whether internal disk drives, tape cartridges. Ex- units, addi-

The Traveling

'tosh

by Frederic E. Davis

DOS portables have been years, but only recently did the fray with its much-awaired tosh Portable. Was it worth-Well, sort of. The Mac Portable few noteworthy features—such amazing 8 hours of battery life, interesting display technology, degree of DOS compatibility—falls far short of the note-book "knowledge navigator" that Apple ballyhooed for so long.

At 16 pounds and \$7,000 for a cal configuration (with a 40MB disk), the Macintosh Portable is hefty both in price and weight. On a 16-MHz 68000 CPU, the Macintosh runs at twice the speed of a Macintosh SE—somewhere in the league 386SX system. For price and performance, the Mac Portable is roughly comparable to Compaq's SLT/286 IBM's PS/2 Model P70 386.

Apple used many tricks to squeeze hours of battery-life out of this system. Using static RAM was one of them. The Mac Portable comes with 1MB static RAM, which is currently expandable to 2MB; future capacity will be 9MB when higher-density static RAM chips become available. Static RAM, unlike the more common dynamic RAM, retains its memory without being refreshed and uses about one-hundredth of the power of the dynamic RAM. Unfortunately, static RAM is more expensive and less available than

tional serial ports, and network adapters can be useful options, especially if a proprietary design squeezes more expandability out of the machine than expansion slots alone would afford.

As in the past, if you need a battery-powered 386, your choices are slim and disappointing. The GRiDCase 1530's internal battery pack, for instance, lasted only 22 minutes on our rundown test, partly as a result of its power-hungry gas plasma display. The Toshiba T3100SX fared better, at almost two and a half hours. A few vendors, such as GRiD and Dolch, offer external battery packs that promise a somewhat more useful battery life, but you won't be thrilled by the prospect of carrying them along.

LOOK THEN FEEL

There are bargains to be found, but again, the quality of the machines varies greatly from vendor to vendor, and quality counts more than ever when you're talking about a machine designed to be carried around. Cases that rattle and don't quite line up, keyboards that latch only with great difficulty to the front of the machine, adjustable screens that don't hold their positions—you'll find these problems in some machines, low- and high-priced.

As usual, in the pages that follow we've given you our subjective impressions of the machines and reported any oddities as well as the indisputable facts. If at all pos-

sible, however, visit a local dealer to tinker with the machine before you buy it. If shopping by mail order, insist on a vendor that offers a 30-day money-back guarantee and a substantial warranty.

Finally, a familiar refrain during the testing of these machines concerned the FCC certification, or lack thereof. Surprisingly, the majority of these machines lack Class B certification. For many, FCC certification was pending at the time of this writing. Chances are slim that hoards of federal agents will descend upon your peaceful home if you dare plug in a Class A device. Aside from federal regulations and interference considerations, chances are you'll get a better-designed, more solid machine.

regular dynamic RAM.

Other power-management tricks include using lead-acid batteries instead of the nickel cadmium batteries found in most portables, including a dedicated microprocessor (Mitsubishi 5073) that manages power consumption by putting the system to sleep (slowing the CPU down from 16 MHz to 1 MHz, powering down the hard disk,

the display isn't backlit. For a nonbacklit reflective LCD screen, the Mac Portable's active-matrix display is great, but it's still hard to read in low lighting.

The rest of the Mac Portable is quite similar to the Macintosh SE except that, instead of a mouse, it has a built-in trackball that can be positioned either to the right or left of the keyboard. Like the SE, the Mac Portable has a SCSI bus port, two serial ports, and a keyboard/mouse



and shutting off the screen) during periods of inactivity, and sacrificing backlighting on the display.

The Mac Portable's display is a mixed blessing. It's an active-matrix LCD with 640 by 400 resolution (similar to monochrome VGA). "Active matrix" refers to the transistor behind each pixel—a technology that Apple was one of the first of the major computer manufacturers to use. The good news is that the display offers excellent contrast and speedy image updates, making it passable for animation software. The bad news is that in order to conserve power and extend battery life,

port. It also has a Processor Direct slot, although it is smaller and not compatible with the SE's internal slot. In addition, the Mac Portable contains an internal RAM expansion port, an internal ROM expansion port (for software applications), an internal modem port, and an external video output port for attaching video monitors or projectors.

Although the Macintosh Portable is not DOS compatible in its native mode, it does offer several levels of DOS compatibility: it comes standard with Apple's new FDHD 1.44MB 3.5-inch floppy disk drive, which reads and writes both Mac and DOS diskettes.

Many Mac applications read and write DOS data formats directly. For those that don't, programs such as *Apple File Exchange Utility* (a \$49 utility that comes free with all Macintosh systems) and *MacLink Plus* from DataViz handle file transfer and translation between many Mac and DOS data formats. Additionally, you can use a remote PC program, such as Dynamic Microprocessor Associates' combination of *pcAnywhere III* on your desktop PC and *PC MacTerm* on your traveling Mac. This duo lets you dial in to your desktop PC and then run DOS programs in a window on your Mac Portable. And if you actually need to run DOS on the Macintosh Portable, *SoftPC* from Insignia Solutions gives you fairly good DOS 3.x compatibility—albeit at a rather sluggish speed, comparable to the old PC XT. (For more information on communicating between a Macintosh and a PC, see "Reconcilable Differences: Mac and PC," *PC Magazine*, April 25, 1989.)

Technically, the Macintosh Portable is impressive. But its price, weight, expensive RAM, and nonbacklit screen are all significant drawbacks. Apple is a late entrant into the portables arena, and its first offering leaves some things to be desired. Of course, if you're on the road a lot, flush with cash, used to heavy lifting, and want to run Mac software with some DOS compatibility, the Macintosh Portable may be an acceptable choice. ■

COMPAQ COMPUTER CORP.

Compaq Portable 386

by Bill O'Brien

Of the several ways to build a lunchbox portable, Compaq has chosen the most difficult: build it from scratch. You won't find jury-rigged motherboards, tight-fitting standard-size I/O cards, or any other cost-saving compromises in this 20-MHz miniature dynamo, which starts at \$7,000. The Portable 386, wrapped in what's become an industry-standard enclosure, is a rugged survivor in the toss-and-carry warfare of day-to-day portable use. And, as you might expect, its work potential leaves little to be desired.

In Compaq's modular design, the internals fit together like some high-tech Rubik's Cube and leave very little possibility of owner intervention. Even if you acquire the special Torx tool necessary to remove the back panel, you'll be faced with a wall of emission-restricting aluminum plate and caging, which earned this machine a Class B FCC rating. The only visible connector is reserved for the external chassis—and that's already accessible to you

without removing the back panel.

The motherboard can accommodate 2MB of SIMM memory, and although you can order a machine with only 1MB, you may find that too little for many of the tasks you'll perform in an 80386 environment. For more than 2MB, you'll need one of Compaq's expansion modules. Luckily, this is the only area where the modular design may prove vexing.

Compaq offers two paths for memory upgrades, a 1- to 2MB expansion card or a 4MB card, but you can use only one or the other. If your intentions are to keep this computer solely as a portable, maxing out your memory at 4MB with the 2MB card will suffice. But the Portable 386 can shoulder up to 10MB if you select the 4MB card, fill it, and then add a 4MB daughterboard to it.

Compaq once again makes good on its policy of outperforming IBM. The Portable 386 surpassed the IBM P70 in almost every benchmark test. Bereft of processor RAM caching, which typically adds muscle to otherwise lackluster memory access, the Portable 386 still managed to undercut the P70's Floating-Point Emulation results. The Instruction Mix and Conventional Memory numbers for the two machines are close, but the Compaq's superior Floating-Point results indicate a combination of processor and RAM activity that more closely resembles a computer's normal activity.

The unit tested by PC Labs included a hard disk with a monstrous maw, capable of devouring 110MB despite its small size. Although our test drive was physically slower than the P70's, the Portable 386's throughput rate allowed its hard disk to breeze by the opposition. And the EGA video electronics built into the motherboard were particularly responsive to direct screen writes, although Compaq's EGA video BIOS couldn't best the speed of the P70's VGA BIOS. Screen readability for the Compaq's gas plasma display, however, is above reproach.

Considered outside of the context of the IBM-Compaq clash of the titans, the Portable 386 is neither the fastest nor the cheapest portable by any means. When connected to its two-slot ISA expansion chassis, it's too awkward to carry, and its EGA/CGA video compatibility is not exactly the hot ticket it once was for portables. But this machine is at its best when purchased with its expansion box and used

as a portable desktop alternative to IBM's MCA machine. If you're looking for a powerful portable with strong desktop potential, you'll find it hard to pass up the Portable 386.

DATA WORLD INC.

Data World Data LP/SX

by Bill O'Brien

The \$3,195 Data World Data LP/SX, with its gas plasma VGA display, is a surprising portable. The fact that it's a 16-MHz 386SX machine is not as noteworthy as it might have been some months ago. But a look inside this AC-powered clamshell reveals an honest-to-goodness small-footprint motherboard complete with a 16-bit slot sprouting an I/O tree with its own slots.

Though other clamshell machines trade expandability for smaller size, there's been no sacrifice in miniaturization to accommodate what Data World refers to as its custom-designed Chicony motherboard. Expansion of the LP/SX, unlike clamshells with card slots, requires that you un-



Compaq Portable 386

Compaq Computer Corp., 20555 State Hwy. 249, Houston, TX 77070; (713) 370-0760.

List Price: With 1MB RAM, 40MB hard disk, 1.2MB 5.25-inch floppy disk drive, EGA gas plasma display, one parallel and one serial port, \$6,999; with 2MB RAM, DOS 3.3, \$7,818; with 110MB hard disk, \$8,818.

In Short: While not the fastest nor the cheapest of the 386 portables, its features, performance, and high-quality construction make the Portable 386 a viable alternative to IBM's P70 MCA machine, which it surpassed in most PC Labs benchmark tests.

CIRCLE 396 ON READER SERVICE CARD



Data World Data LP/SX

Data World Inc., 3733 San Gabriel River Pkwy., Pico Rivera, CA 90660-1404; (800) 722-7702, (213) 695-3777.

List Price: With 1MB RAM, 40MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA gas plasma display, one parallel port, two serial ports, carrying case, \$3,195; with 4MB RAM, 104MB hard disk, DOS 3.3, \$3,992.

In Short: The 16-MHz, AC-powered Data World Data LP/SX offers lots of expandability, good VGA video performance, and a useful, clear front panel.

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PORTABLES 386- AND 386SX-BASED

bolt the cover and insert your own boards. If you're brave enough to take the plunge, you'll have something unusual: true 386 expandability in a clamshell portable.

The LP/SX's case is more expandable, though no larger, than the Toshiba T5200's, and after reviewing a wave of lunchboxes, it was gratifying to see a prominently placed bank of LEDs indicating speed, power, and turbo modes right on the display panel, rather than hidden in some corner. Also welcome was the inclusion of a partially recessed (and therefore difficult to accidentally press) reset button immediately to the left of the LED display.

The base model comes with 1MB of 4-by-256Kb DIPs, which you remove from the motherboard to install an expansion memory card (the entire keyboard section lifts out to permit the upgrade). The maximum memory on this card is 4MB—something worthy of consideration at the time of purchase, since many 80386 software packages won't run in the restrictive 1MB environment.

The LP/SX is a video wiz. The benchmark test results in text handling show its VGA card to be faster than some of the CGA machines in this feature. Its mono-

chromatic gas plasma screen can be set for a variety of modes, including 16 gray scales and inverse video. Unhappily, the range of adjustment available from the single brightness control is not quite adequate to maintain distinctions among the shades. Even so, you can easily connect an exter-

**The Data LP/SX is a
video wiz. Its VGA card
is faster than some CGA
machines in this feature.**

nal monitor and revel in the full color of VGA's 640 by 480 pixels.

One final item to consider afflicts quite a few portables in this roundup and may be worth considering. The LP/SX received a Class A FCC rating, which restricts its use to a commercial, factory, or office envi-

ronment. You can take the LP/SX with you, but if you want to stay within the limits of the FCC law, you can't use it at home.

DATA WORLD INC.

Data World

Portacomp 386-20

by Bill O'Brien

Data World's flagship entry into the portable computer arena is the 80386-based, 20-MHz Portacomp 386-20, priced starting at \$3,035. With its gas plasma display, it's an AC-powered tempest in a lunchbox that, in spite of a few design quirks, is more than adequate for the job at hand.

The 386-20 uses an Orchid Privilege active backplane that's been customized for the 80386's 32-bit data path. Because it was originally designed around the 16-bit architecture of the SX version of the chip, some compromises were made to accommodate the 80386. As installed in the review machine, memory comprises a combination of DIPs and SIMMs to reach the

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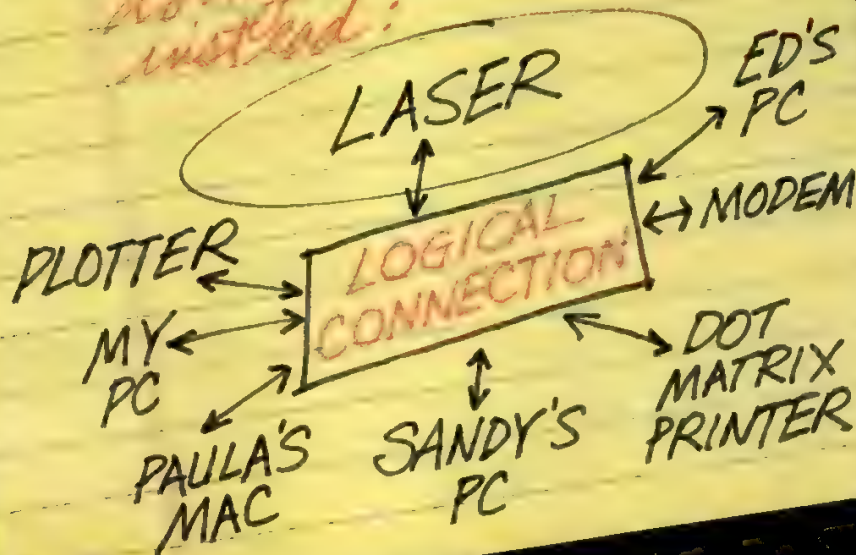
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386- AND 386SX-BASED PORTABLES: SUMMARY OF FEATURES

Price of standard configuration To allow price comparisons, our standard configuration for 80286-based portables includes 1MB RAM, a 20MB or larger hard disk, one floppy disk drive, a display, one parallel and one serial port, and DOS. For 80386-based portables, we requested 2MB RAM and at least a 40MB hard disk. In some instances, manufacturers do not offer the exact configuration *PC Magazine* requested; check each machine's fact file for a more exact indication of what is included at the quoted price.

Case type indicates whether the computer has a clamshell (laptop) or lunchbox design.

Display system indicates the maximum video mode supported by the portable's display.

Display technology Among portables, standard displays include electroluminescent, gas plasma, and liquid crystal displays. All of the portables included in these tables feature back-lighting unless otherwise noted.

Chip set manufacturer indicates which company makes the logic that connects the CPU with the other functions supported by the system board. Chip sets that employ VLSI technology (very large scale integration) reduce the discrete component count, which helps to reduce power consumption and increase component life.

The system RAM arrangement refers to the method by which memory is addressed.

Remember that CPU speed is usually faster than conventional memory speed.

Interleaved memory increases processing speed by dividing the memory into two or four portions that process information alternately. The CPU sends information to one section for processing while another section goes through a refresh cycle.

Page-mode memory allows back-to-back memory accesses within blocks of memory called pages, thereby avoiding wait states.

Row/column is the traditional method of accessing data at a memory address, with the RAM being mapped as a matrix and a particular address being given using a row and a column number.

In **static-column** memory, once data is located at a specific column address, subsequent pieces of data are accessed or allocated to the same column. Because the column is "static," data retrieval is faster.

Wait states On the average, most machines run at between zero and one wait state. The figures printed here were supplied by the respective manufacturers.

A **processor RAM cache** acts as a bridge between the CPU and the slower main memory. The cache comprises a small bundle (typically 32K to 128K) of fast SRAM chips. The cache controller is designed to predict and retrieve the data the CPU is likely to require next, thus preventing wait

states. There are two varieties of controllers: discrete logic chips (designed by the individual manufacturers) and VLSI chips like the Intel 82385.

Maximum installable RAM Separate rows indicate the maximum 32-bit memory possible for a 386-based PC—or the maximum 16-bit memory for a 286 or 386SX machine—on the motherboard and on a dedicated memory board, as well as the maximum size of the processor RAM cache.

RAM packaging (and rated speed) Memory chips come in a variety of styles: DIPs, SIPs, and SIMMs.

The **dual in-line package (DIP)** is the traditional buglike computer chip sprouting 8, 14, 24, 40 or more metal legs (evenly divided between right and left sides).

Single in-line packages (SIPs) are single-package arrays of computer chip logic assembled so that all connecting legs are in a straight line, like the teeth on a comb. They can be individual chips or multiple chips on a small card, with a proprietary SIP connection. Similar to SIPs are **ZIPs (zig-zag in-line packages)**, in which every other pin connection is slightly offset, creating a zig-zag pattern.

Single in-line memory modules (SIMMs) are individual logic devices that are installed on their own small circuit board, creating a component module that can be plugged into a larger device. Their physical arrangement facilitates easy installation and replacement.

	Compaq Portable 386	Data World Data LP/SX	Data World Portacomp 386-20	Dauphin Crown SX	 Dell 316LT	 Dolch P.A.C. 386-20	 Dolch P.A.C. 386-25C
Price of standard configuration	\$7,818	\$3,195	\$3,417	\$4,995	\$4,099	\$6,645	\$8,145
Microprocessor	20-MHz 80386	16-MHz 80386SX	20-MHz 80386	16-MHz 80386SX	16-MHz 80386SX	20-MHz 80386	25-MHz 80386
Power supply type	AC only	AC only	AC only	Battery	Battery	AC only	AC only
Case type	Lunchbox	Clamshell	Lunchbox	Clamshell	Clamshell	Lunchbox	Lunchbox
Dimensions (HWD, in inches)	8.2 x 16.1 x 9.8	4 x 14.5 x 13.5	9.5 x 15.5 x 8	3.3 x 12.8 x 16.3	3.4 x 12.7 x 14.3	10 x 15.8 x 8.3	10 x 15.8 x 8.3
Weight (lbs.)	20	15.4	22	16.8	15	20.9	22.4
Display system	EGA	VGA	EGA	EGA	VGA	VGA	VGA
Display technology	Gas plasma	Gas plasma	Gas plasma	LCD	LCD	Gas plasma	Gas plasma
Maximum resolution (pixels)	640 x 400	640 x 480	640 x 350	640 x 400	640 x 480	640 x 480	640 x 480
Motherboard manufacturer	Compaq	Chicony	Orchid	Dauphin	Kyocera	Monolithic	Monolithic
Chip set manufacturer	Compaq	Core Logic, Intel	Chips and Technologies	VLSI	Kyocera	Chips and Technologies	Chips and Technologies
System RAM arrangement	Page mode	Interleaved	Interleaved	Interleaved, row/column	Page mode	Interleaved	Page mode
Wait states	0	0.7	0	0	0	0	0
PROCESSOR RAM CACHE							
Cache controller manufacturer	N/A	N/A	N/A	N/A	N/A	N/A	Chips and Technologies
Installed RAM	N/A	N/A	N/A	N/A	N/A	N/A	32K
Maximum installable RAM	N/A	N/A	N/A	N/A	N/A	N/A	32K
Rated speed	N/A	N/A	N/A	N/A	N/A	N/A	25 ns.
MOTHERBOARD MEMORY							
Installed RAM	2MB	None	2MB	4MB	2MB	2MB	2MB
Maximum installable RAM	2MB	1MB	2MB	4MB	8MB	8MB	8MB
RAM packaging and rated speed	SIMM (80 ns.)	DIP (100 ns.)	SIMM, DIP (80 ns.)	DIP, SIP (80, 100 ns.)	SIMM (100 ns.)	SIP (80 ns.)	SIP (80 ns.)
Chip size	1Mb	4 x 256Kb	256Kb	1Mb	256Kb	256Kb	256Kb

—Editor's Choice

N/A—Not applicable: the product does not have this feature.

Chip size Kb and Mb refer to kilobits and megabits, respectively. Combination chips (4 x 256Kb) are generally faster and more expensive.

The BIOS version and date can affect PC Labs' benchmark test results. Those purchasing the same machine with a different BIOS version may encounter some variations in performance.

Shadowing Shadow RAM is a technology that loads system BIOS and/or video BIOS directly into fast RAM on boot-up of the computer, offering enhanced performance speed at the cost of 384K of memory from the first 1MB of system RAM.

Hard disk options The number of different hard disks the vendor offers for a machine is often indicative of how much customizing is available.

Within the PC environment, the three most common hard disk interfaces are *ST-506*, *SCSI* (small computer system interface), and *ESDI* (enhanced small device interface). ST-506 uses one of two data encoding methods, *RLL* (run length limited) and the older *MFM* (modified frequency modulation) scheme. All data is encoded onto and read from your hard disk as a series of polarity-reversing bits representing ones and zeros. The MFM format uses nine such bits to store the same amount of data that RLL can store with only six polarity changes.

Both SCSI and ESDI require special hard disk controllers and cannot run off existing PC-XT or PC AT controllers. *IDE* (interface design

enhancements) is a new interface that incorporates the controller onto the hard disk and uses RLL encoding.

Bus speeds Bus speed becomes more important as computers run at faster clock speeds. A computer's bus speed may actually be too fast for expansion cards, most of which operate at 8 MHz. Note that the Micro Channel bus in the IBM PS/2 Model P70 386 operates at 10 MHz.

Available slots represents the number of open, usable expansion slots in the tested unit.

Display circuitry location The display circuitry can be either on an expansion card or integrated onto the motherboard.

Interface 16-bit video interfaces are typically faster than 8-bit because of their wider bandwidth.

Software available Where OS/2 is available, the version number and list price are provided. DOS 3.3 or 4.01 is automatically included as part of *PC Magazine's* standard configuration for computers.

Disk caching software Some companies provide software to facilitate data retrieval from the hard disk.

An expanded memory manager is software that emulates the Lotus/Intel/Microsoft (LIM) expanded memory manager within the extended memory of a 386 or 386SX PC.

A switchable power supply permits a computer's use in both the United States and Europe.

Number of device connectors indicates how many internal storage devices the system can support without the use of Y cables (power splitters).

Battery Portables can contain either a fixed internal battery or a removable one that allows for external recharging. Typical **battery materials** include lead acid and nickel cadmium.

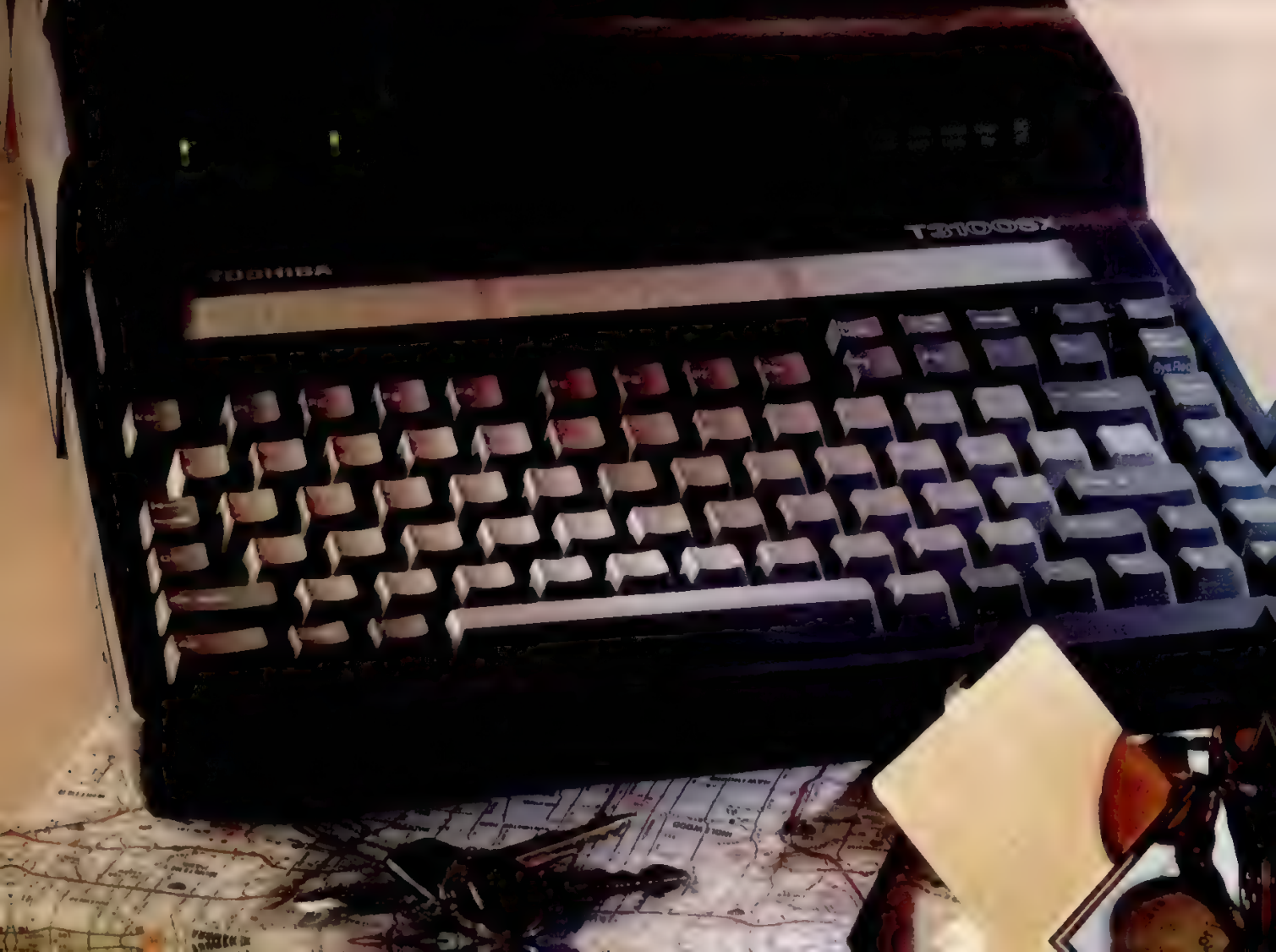
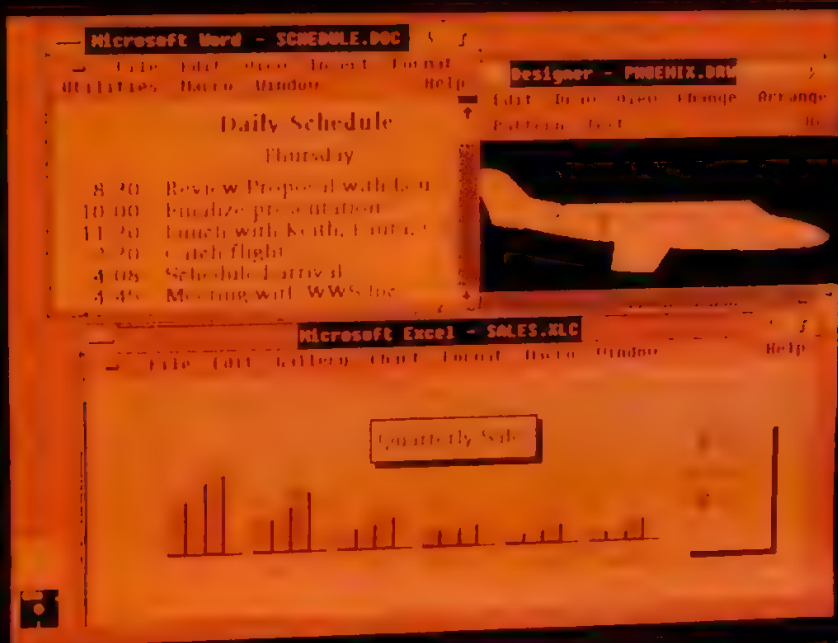
The **transformer weight and size** are given as an indication of how portable the entire laptop system actually is.

Connectivity Network cards designed for specific portables may be offered for sale by the vendor or a third party. Keep in mind that any portable that includes a full-length 8- or 16-bit expansion slot can accept any standard network card.

FCC certification class Two classes of FCC (Federal Communications Commission) approval, Class A and Class B, may be given to computers. Class A approval signifies that a computer has sufficiently low radio-frequency emissions for operation in a business locale. The more stringent Class B rating allows home use as well, where computers are likely to be placed near radios and television sets.

GRIDCase 1530	GRIDCase 1535 EXP	IBM PS/2 Model P70 386	Blue Max Attache 386	Maxtron LCD Portable 386	Micro Express Regal SX	Micro Express Regal II	Micro Teleels 386 Portable
\$7,115	\$8,340	\$7,820	\$6,384	\$4,043	\$2,774	\$3,274	\$2,795
12.5-MHz 80386	12.5-MHz 80386	20-MHz 80386	33-MHz 80386	25-MHz 80386	20-MHz 80386SX	25-MHz 80386	20-MHz 80386
Battery	Battery	AC only	AC only	AC only	AC only	AC only	AC only
Clamshell	Clamshell	Lunchbox	Briefcase	Lunchbox	Lunchbox	Lunchbox	Lunchbox
2.5 x 11.5 x 15.1	2.5 x 11.5 x 15.1	12 x 18 x 5	8.5 x 17.5 x 16	9.5 x 15.8 x 8	9.4 x 15.75 x 8.4	4.4 x 15.75 x 8.4	9.6 x 16.3 x 8.8
14.8	12.6	20.8	32	20.7	22.3	22.7	23.2
CGA	CGA	VGA	CGA	EGA	EGA	EGA	EGA
Gas plasma	LCD	Gas plasma	Monochrome CRT	LCD	Gas plasma	Gas plasma	Gas plasma
640 x 400	640 x 400	640 x 480	720 x 348	640 x 400	640 x 400	640 x 400	640 x 400
GRiD Systems	GRiD Systems	IBM	AMI	Bison	InformTech	AMI	Unitron
Faraday	Faraday	IBM	Chips and Technologies	Chips and Technologies	Chips and Technologies	Chips and Technologies	Chips and Technologies
Row/column	Row/column	Row/column	Row/column	Interleaved	Interleaved, page mode	Page mode	Row/column
1	1	0.5	0	0	0	0	0
N/A	N/A	N/A	Nissarte Logic	N/A	N/A	AMI	N/A
N/A	N/A	N/A	64K	N/A	N/A	64K	N/A
N/A	N/A	N/A	64K	N/A	N/A	64K	N/A
N/A	N/A	N/A	150 ns.	N/A	N/A	25 ns.	N/A
1MB	2MB	8MB	4MB	2MB	2MB	None	1MB
8MB	8MB	8MB	32MB	8MB	2MB	N/A	8MB
SIP (120 ns.)	SIP (120 ns.)	SIMM (85 ns.)	SIMM (70 ns.)	SIP (80 ns.)	DIP (80 ns.)	N/A	SIP (100 ns.)
256Kb	256Kb	256Kb	1Mb	256Kb	256Kb	N/A	256Kb, 1Mb

CONTINUES



We've pulled the plug on 386SX technology.

The top of a desk is no longer the only place 386-based computing gets done. That's because we've come up with a battery-powered alternative that works anywhere.

It's known simply as the T3100SX.

First of all, we gave it a powerful 386SX processor. So it can handle multitasking operating environments like Windows 386 and OS/2 with ease.

Next, we devised an ingenious display system unlike anything you've ever seen on a battery-powered portable. It combines both VGA and gas plasma technology, boasts a 100:1 contrast ratio and can support both an internal display and an external monitor simultaneously.

Finally, we gave it a 40MB hard disk, a 1.44MB 3.5" floppy disk drive and 1 megabyte of RAM, which you can expand

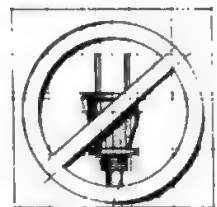
The T3100SX's slim case is only 3.15 inches thick and weighs just 14.9 pounds including its two standard batteries.

up to 13MB. All in an easy-to-carry, 14.9-pound package that goes wherever your work is.

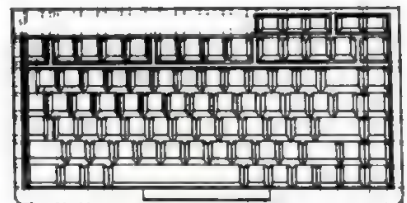
So now you can put the latest 386 computing power to work for you, even if there isn't a plug anywhere in sight.

The Toshiba T3100SX. Take it. See how far you can go.

T3100SX: 14.9 pounds, 16MHz 386SX with 80387SX math coprocessor socket; 40MB hard disk with 25msec access, two removable, rechargeable batteries; three dedicated Toshiba memory slots, one dedicated Toshiba modem slot, one Toshiba general purpose slot; 1MB RAM expandable to 13MB, gas plasma VGA display with 16 gray scales and 100:1 contrast ratio; 1.44MB 3 1/2" diskette drive. For more information call 1-800-457-7777.



Since the T3100SX is battery operated, you can utilize powerful 386 applications anywhere you choose.



The ergonomically-designed 86-key keyboard features eight dedicated cursor control keys, 12 function keys and a numeric keypad.

In Touch with Tomorrow
TOSHIBA

Toshiba America Information Systems Inc., Computer Systems Division

CIRCLE 379 ON READER SERVICE CARD

PORTABLES

386- AND 386SX-BASED



386- AND 386SX-BASED PORTABLES: SUMMARY OF FEATURES

	National Micro Systems Gas Plasma 386SX-16 \$2,749	National Micro Systems Gas Plasma 386-25 \$3,698	NEC PowerMate Portable SX \$5,999	NEC ProSpeed CSX Color Laptop Computer \$8,499	NEC ProSpeed 386 Laptop Computer \$6,599	Pan United Micro Labs 386/20L \$4,226	PC Brand 386/SX-16 Portable III \$2,759
Price of standard configuration							
TESTED CONFIGURATION							
Microprocessor	16-MHz 80386SX	25-MHz 80386	16-MHz 80386SX	16-MHz 80386SX	16-MHz 80386	20-MHz 80386	16-MHz 80386SX
Power supply type	AC only	AC only	AC only	AC only	Battery	AC only	AC only
Case type	Lunchbox	Lunchbox	Lunchbox	Clamshell	Clamshell	Lunchbox	Lunchbox
Dimensions (HWD, in inches)	9.8 x 16 x 8.8	9.8 x 16 x 8.8	11.3 x 16 x 8	4 x 15 x 14.5	4 x 15.5 x 13.5	9.9 x 16 x 9.1	10.5 x 16 x 8.7
Weight (lbs.)	22	22.8	21.5	18.5	22	22.6	24.2
Display system	CGA	CGA	VGA	EGA	EGA	VGA	VGA
Display technology	Gas plasma	Gas plasma	Gas plasma	Color LCD	LCD	Gas plasma	Gas plasma
Maximum resolution (pixels)	640 x 400	640 x 400	640 x 480	640 x 400	640 x 400	640 x 480	640 x 480
Motherboard manufacturer	InformTech	AMI	NEC	NEC	NEC	AMI	PC Brand
Chip set manufacturer	Chips and Technologies	Chips and Technologies	Intel	Chips and Technologies	Chips and Technologies	Micro Mx	Chips and Technologies
System RAM arrangement	Interleaved, page mode	Interleaved, page mode	Interleaved, page mode	Interleaved, page mode	Interleaved, page mode	Page mode	Interleaved, page mode
Wait states	0	0	0.6	0.6	0.6	0	0
PROCESSOR RAM CACHE							
Cache controller manufacturer	N/A	Discrete logic	N/A	N/A	N/A	AMI	N/A
Installed RAM	N/A	64K	N/A	N/A	N/A	64K	N/A
Maximum installable RAM	N/A	64K	N/A	N/A	N/A	64K	N/A
Rated speed	N/A	25 ns.	N/A	N/A	N/A	25 ns.	N/A
MOTHERBOARD MEMORY							
Installed RAM	1MB	None	2MB	2MB	2MB	None	5MB
Maximum installable RAM	2MB	N/A	2MB	2MB	2MB	N/A	16MB
RAM packaging and rated speed	DIP (80 ns.)	N/A	SIP (80, 100 ns.)	ZIP (80 ns.)	DIP (100 ns.)	N/A	SIP (80, 100 ns.)
Chip size	256Kb	N/A	256Kb, 1Mb	256Kb	256Kb	N/A	256Kb, 1Mb
ADD-IN MEMORY BOARD							
Installed RAM	N/A	4MB	N/A	None	2MB	1MB	N/A
Maximum installable RAM	N/A	16MB	N/A	2MB	2MB	2MB	N/A
RAM packaging and rated speed	N/A	DIP (80 ns.)	N/A	ZIP (80 ns.)	DIP, ZIP (100 ns.)	DIP (100 ns.)	N/A
Chip size	N/A	1Mb	N/A	256Kb	256Kb, 1Mb	256Kb	N/A
BIOS							
BIOS version and date	Phoenix 1.10.12 (January 1988)	AMI 3606 (April 1989)	Phoenix 1.10.54 (January 1988)	Phoenix 1.10.31 (January 1988)	Phoenix 1.10 (November 1988)	AMI 3601-L8 (March 1989)	AMI DNSX-5004 (April 1989)
Password in ROM	☐	☐	☐	☐	☒	☐	☐
Video shadowing	☒	☒	☒	☒	☐	☒	☒
System shadowing	☒	☐	☒	☒	☒	☒	☒
COPROCESSOR							
Coprocessor supported	80387SX-16	80387-25	80387SX-16	80387SX-16	80387-16	80387-20	80387SX-16
Supports 387 and Weitek coprocessors simultaneously	N/A	N/A	N/A	N/A	N/A	N/A	N/A
HARD DISK							
Manufacturer	Seagate	CDC	NEC	NEC	Conner	Seagate	MiniScribe
Disk capacity	43MB	80MB	42MB	42MB	42MB	42MB	150MB
Interface	ST-506	ST-506	ST-506	ST-506	IDE	ST-506	ESDI
Average access time (milliseconds)	24	21	28	28	28	25	17
Controller manufacturer	DTC	Western Digital	National Computer Ltd.	NEC	Conner	National Computer Ltd.	Adaptec
Hard disk options	100MB SCSI	40MB ST-506; 100MB IDE	None	100MB ESDI	100MB ESDI	20MB, 60MB ST-506	40MB, 66MB, 71MB, 110MB ST-506

☒—Editor's Choice ☒—Yes ☐—No

N/A—Not applicable: the product does not have this feature.

PORTABLES

386- AND 386SX-BASED

PC Brand 386/20 Portable III \$4,125	PC Brand 386/25 Portable III \$4,349	Tangent 386/25 Portable \$2,650	Toshiba T3100SX \$7,098	Toshiba T3200SX \$7,398	Toshiba T5100/100 \$7,499	Toshiba T5200/100 \$7,699	Zenith SupersPort SX \$6,799
20-MHz 80386 AC only Lunchbox 10.5 x 16 x 8.7 24.8 VGA Gas plasma 640 x 480 PC Brand Chips and Technologies Page mode 0	25-MHz 80386 AC only Lunchbox 10.5 x 16 x 8.7 25.1 VGA Gas plasma 640 x 480 PC Brand Chips and Technologies Interleaved, page mode 0	25-MHz 80386 AC only Lunchbox 10.4 x 15.9 x 8.5 22 EGA Gas plasma 640 x 400 Data Expert Chips and Technologies Interleaved 0	16-MHz 80386SX Battery Clamshell 3 x 12 x 14 14.6 VGA Gas plasma 640 x 480 Toshiba Toshiba Row/column 1	16-MHz 80386SX AC only Clamshell 3.9 x 14.6 x 15.6 17.2 VGA Gas plasma 640 x 480 Toshiba Toshiba Row/column 1	16-MHz 80386 AC only Clamshell 3.6 x 12.3 x 14.3 14.9 EGA Gas plasma 640 x 480 Toshiba Intel Static column, page mode 1	20-MHz 80386 AC only Clamshell 3.9 x 14.6 x 15.6 18.7 VGA Gas plasma 640 x 480 Toshiba Toshiba Row/column 1	16-MHz 80386SX Battery Clamshell 3 x 12 x 15 17 VGA LCD 640 x 480 Zenith Zenith Interleaved, page mode 0
N/A	N/A	N/A	N/A	N/A	N/A	Intel 82385	N/A
N/A	N/A	N/A	N/A	N/A	N/A	32K	N/A
N/A	N/A	N/A	N/A	N/A	N/A	32K	N/A
N/A	N/A	N/A	N/A	N/A	N/A	35 ns.	N/A
8MB 16MB SIP (80 ns.) 1Mb	8MB 16MB SIP (80 ns.) 1Mb	8MB 8MB SIMM (80 ns.) 1Mb	1MB 13MB DIP (80 ns.) 4 x 256Kb	3MB 13MB DIP, SIMM (80 ns.) 4 x 256Kb, 1Mb	2MB 4MB SIMM (80 ns.) 256Kb	2MB 8MB SIMM (85 ns.) 1Mb	2MB 8MB DIP (100 ns.) 1Mb
N/A	N/A	None	N/A	N/A	N/A	N/A	N/A
N/A	N/A	8MB	N/A	N/A	N/A	N/A	N/A
N/A	N/A	DIP (80 ns.)	N/A	N/A	N/A	N/A	N/A
N/A	N/A	256Kb, 1Mb	N/A	N/A	N/A	N/A	N/A
AMI DC2T-5004 (April 1989)	AMI DC2T (April 1989)	AMI V2.4 (March 1989)	Award 1.20 (September 1989)	Award 1.10 (July 1989)	Award 2.30 (April 1989)	Award 1.20 (October 1988)	Zenith (1989)
☐	☐	☐	☐	☐	☐	☐	☐
■	■	None	☐	☐	■	■	■
■	■	None	■	☐	■	■	■
80387-20 N/A	80387-25 N/A	None N/A	80387SX-16 N/A	80387SX-16 N/A	80387-16 N/A	80387-20 N/A	80387SX-16 N/A
MiniScribe 150MB ESDI 17 Adaptec	MiniScribe 150MB ESDI 17 Adaptec	CDC 110 MB ESDI 18 DTC	JVC 40MB Proprietary 25 JVC	Conner 40MB IDE 25 Conner	Conner 104MB IDE 25 Conner	Conner 104MB IDE 25 Conner	Conner 42MB IDE 25 Conner
40MB, 66MB, 71MB, 110MB ST-506	40MB, 66MB, 71MB, 110MB ST-506	20MB, 30MB, 40MB, 67MB ST-506; 150MB, 200MB ESDI; 80MB SCSI	None	None	None	None	104 MB IDE

CONTINUES

There's gold

Now, Quarterdeck's new

Memory is gold.

And like gold, some of it is hidden away inside your computer. For years, we've been working toward putting it all under your control. And now we can.

Now you can make today's more powerful programs run without giving up network and mouse drivers and TSRs.

Introducing Manifest—the Quarterdeck memory analyzer

Many PC users know there are nuggets of memory sitting unused in most PCs. But those little pieces of memory can add up to 130K!

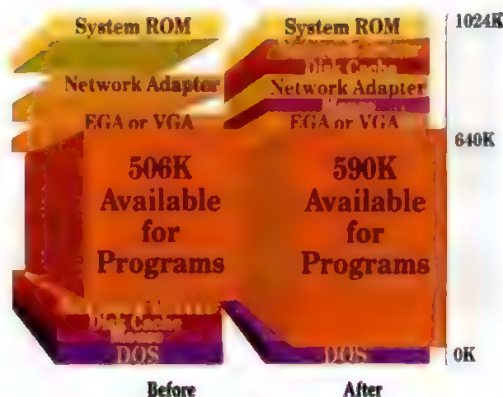
That's why Quarterdeck Office Systems, publisher of DESQview, developed a new utility that helps you find and use this memory. It's called Manifest. And it does for memory what PC Tools does for disks. For under \$60.

Quarterdeck's seven years of memory expertise made Manifest

Manifest guides you deep inside your PC.

It locates unused (or underused) memory and suggests where you could load networks, buffers, mouse drivers, TSRs and other utilities to increase performance. It even analyzes what type and amount of RAM you have available, and which portions of your memory are faster.

Administering a number of PCs? Manifest's diagnostic and reporting capabilities reduce technical support time. It not only identifies problems but helps to solve them.



Your current memory is full of holes. Our tools can fill blocks of unused addresses between 640K and 1024K to free up memory your programs can use.

Manifest shows you the contents of AUTOEXEC.BAT and CONFIG.SYS files. That can be a big help when diagnosing problems. Manifest tells you all about your hardware, too—from your CPU type to what boards you have installed. Manifest even tests memory speed.

And it runs benchmark tests on expanded memory boards so you can make informed buying decisions.

You won't need a PhD to understand what you're doing. Manifest has an interactive 'manual' that tells you how to use the program and what benefits you'll get.

And unlike a lot of hot new software, Manifest works on virtually any PC: 8088, 8086, 80286 or 80386. It's a productivity breakthrough from the memory experts at Quarterdeck.

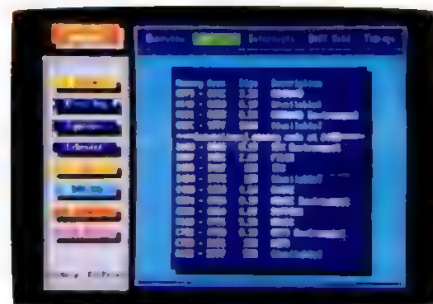
Introducing QRAM—the Quarterdeck memory optimizer

End RAM cram in your 8088, 8086 or 80286 PC once and for all. QRAM (pronounced cram), is a package of utilities that gives you unprecedented control over memory, letting you set up your memory the way it will work best for you.

If you have EMS 4.0 or EEMS boards, QRAM can find unused addresses and 'map' memory to those addresses. Then it looks at your AUTOEXEC.BAT and CONFIG.SYS files and figures out what TSRs, network and mouse drivers and DOS resources can be loaded high and where.

And, like all Quarterdeck memory products, QRAM is compatible with the Microsoft XMS specification used by Windows 286, V. 2.x.

If your PC has 'shadow RAM,' there's even more gold in your PC. QRAM finds the unused



QRAM optimizes your memory performance by moving utilities and drivers out of the area between 0K 640K—freeing it up for your programs to use.

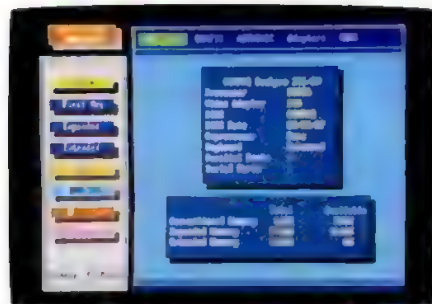
parts and puts them under your control.

And if you have an EGA or VGA-equipped PC and don't need graphics at the moment, QRAM will make an additional 96K 'nugget' of memory available! When you need graphics again, QRAM will switch you back to graphics mode! Think how helpful that will be for those big dBASE files.

QRAM can't work miracles, but if there's memory available anywhere, QRAM lets you use it to increase your PC's speed and performance.

QRAM is available bundled with Manifest for just a few dollars more than Manifest alone.

Manifest and QRAM—two more examples of Quarterdeck's commitment to mining the most productivity out of the PC and software you own today.



Manifest shows you what's 'under the hood' of your PC.

in your PC. tools can mine it for you.

Introducing QEMM 50/60 Version 5.0

QEMM (Quarterdeck Expanded Memory Manager) 50/60 is the gold standard in memory management for the IBM PS/2™ series 50 and 60. It works with IBM's Memory Expansion Option, Expanded Memory Adapter/A and compatible memory boards.

It supports all three specifications for expanded memory: EMS 4.0, EMS 3.2 and EEMS memory so you can run all expanded memory programs.

And it also works with Microsoft's XMS specification, in case you want to use Windows.

QEMM lets you use memory locations between 640K and 1024K to run TSRs, mouse and network drivers, DOS resources and MCA adaptors. That means you can gain up to 130K of memory space below 640K for your programs.

Best of all, QEMM is designed to be easy to use—even for those new to the PC. Just install it and type 'optimize,' and it looks at your AUTOEXEC.BAT and CONFIG.SYS files and loads whatever it can in high memory. Automatically.

QEMM 50/60 is priced economically. It's the biggest boost you can give your PS/2 for under \$100.



System Requirements

Manifest: 8088, 8086, 80286 80386 and i486 PCs & PS/2s

QRAM: 8088, 8086, 80286 PCs. Use of high memory is only available when PC has EMS 4 or EEMS expanded memory or Chips & Technologies shadow RAM.

QEMM 50/60: 80286-based PS/2s and compatibles with IBM PS/2 80286 Memory Expansion Option, IBM PS/2 80286 Expanded Memory Adapter/A or compatible.

QEMM-386: 80386-based PCs and PS/2s and PCs with 80386 add-in boards.

Trademarks: IBM, PS/2, IBM Corporation, PC Tools, Central Point Software, 80386, i486: Intel Corporation, Chips and Technologies, Chips and Technologies



QEMM and DESQview let you multitask and window with the programs you know and use today.

Introducing QEMM 386 Version 5.0

QEMM 386 can expand the memory of all 386-based computers, including PCs with 80386 upgrade boards. It makes your memory compatible with EMS 4.0, EMS 3.2 and EEMS memory without having to add special hardware. It's compatible with protected-mode programs (like 1-2-3 Release 3, IBM Interleaf and Paradox 386) using DOS extenders compatible with the Quarterdeck/Pharlap VCPi spec.

QEMM also works with Microsoft's XMS spec to extend memory for Windows users.

QEMM gives you maximum control over your memory between 640K-1024K. It can find unused memory nuggets as small as 4K and use them to free up room for programs to use.

QEMM 386 even monitors how your programs use memory while they're running. Then it shows you where there's additional memory you can use. It even measures which parts of your memory are fastest and 'decides' how to use them for better performance. In action, it's easy and fun—almost like having an *artificial intelligence* program to help tune up your PC.

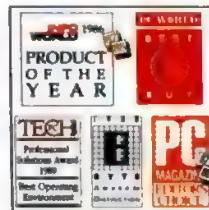
All these capabilities add up to greater performance at a very low cost. And QEMM lets you go for the gold without having to become an expert on the PC memory puzzle.

Like all Quarterdeck products, it works with your current PC and favorite software.

A few words about DESQview

What's the smartest thing to do with all that additional memory? Run DESQview and multitask your favorite programs in windows. Use a mouse or keyboard and you can run graphic and text-based programs side-by-side. All without having to invest in a bigger hard disk or more memory.

From Manifest to QRAM, QEMM and DESQview, Quarterdeck helps you mine the most from the software and PC you have today.



DESQview's recent awards.

Quarterdeck

150 Pico Boulevard, Santa Monica, CA 90405 (213) 392-9851 Fax: (213) 399-3802

Qty		Product	5-1/4	3-1/2	Each	Totals
		Manifest 1.0			\$59.95	
		QRAM and Manifest 1.0			\$79.95	
		QEMM 50/60 5.0 (with Manifest*)			\$99.95	
		QEMM 386 5.0 (with Manifest*)			\$99.95	
Shipping & Handling			\$5 in USA/ \$10 outside USA			
			California Residents add 6.5%			
			Grand Total			

Yes! I need increased productivity on my current PC!

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Card #

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CIRCLE 338 ON READER SERVICE CARD



Data World Portacom 386-20

Data World Inc., 3733 San Gabriel River Pkwy., Pico River, CA 90660-1404; (800) 722-7702, (213) 695-3777.

List Price: With 1MB RAM, 20MB hard disk, 1.44MB 3.5-inch floppy disk drive, external 1.2MB 5.25-inch floppy disk drive, EGA gas plasma display, one parallel and two serial ports, carrying case, \$3,035; with 2MB RAM, 40MB hard disk, DOS 3.3, \$3,417; with 104MB hard disk drive, DOS 3.3, \$3,694.

In Short: While the Portacom 386-20 is a well-designed portable and provides some of the amenities of a desktop unit, its small memory limits its usefulness in a true 386 environment.

CIRCLE 307 ON READER SERVICE CARD

motherboard's maximum 2MB. There are no 32-bit slots in this machine, and the single proprietary slot is taken by the Orchid CPU card. No 32-bit memory expansion is possible.

Although the machine's memory capacity is limited, there are few DOS applications that won't run in 2MB. This computer isn't suited to serve as a mobile desktop system that provides a lot of expandability. And for now, its Class A rating limits its use to commercial areas.

Putting even a small-footprint board like the Privilege into a lunchbox housing does offer some restrictions. Only two 16-bit slots are available for expansion after the CPU and video boards are in place. Because of their positions under the 150-watt Flow Max power supply, several slots are inaccessible. In fairness to Data World, this condition is not uncommon in portables that use similar enclosures.

The disk drives are of particular note. Data World shipped the review machine with a 104MB Connor IDE hard disk. Its controller incorporates a 32K write-back cache, making the drive system particularly fast. To maintain compatibility with desktop systems, the base price of the computer includes not only the internal 3.5-inch floppy disk drive, but an external

5.25-inch floppy disk drive as well.

Where you and the machine must interact, the Portacom 386 is well designed. It supports an EGA video card with an external port for monitor connection. The gas plasma screen can display up to eight shades of gray.

The keyboard was one of my favorites. Data World has adopted a scaled-down Chicony keyboard for this machine. The key response is firm, but may be too firm for some. Likewise, the mechanical audible feedback from the key switches may not be to everyone's taste.

The Portacom 386-20 is an attractive carry-along workhorse, despite its memory limitations. Its processing speed and disk access ratings place it among the better desktops, and it is well priced.

DAUPHIN TECHNOLOGY INC.

Dauphin Crown SX

by Bruce Brown

The first thing you'll notice about the 80386SX-based, 16-MHz Crown SX is its price: at \$4,995, it costs only a little more than some major vendors' 286 laptops. But before you get the idea that this low price means fewer features, read on: your five grand buys a clamshell machine with 2MB RAM, a 40MB hard disk and a 1.44MB 3.5-inch floppy disk drive, a fine EGA supertwist backlit LCD display, one parallel and two serial ports, and an interesting assortment of software.

Instead of MS-DOS, the Crown SX comes with DR-DOS, Digital Research's DOS-compatible operating system with extra features and friendlier user prompts. Standard software also includes Traveling Software's *Lap Link* file-transfer program and Alpha Software Corp.'s *AlphaWorks*—a fine, moderate-power, integrated program that has modules for word processing, spreadsheet, database management, and telecommunications.

The Crown SX runs on either internal, lead acid batteries, which are removable and rechargeable, or via an internal AC adapter or a standard car battery adapter. It's mighty convenient to have both the batteries and the power transformer inside, saving space though not weight (the Crown SX weighs 16.77 pounds).

For AC operation only, remove the 3.6-pound battery. The battery is rated at 1



Dauphin Crown SX

Dauphin Technology Inc., 1125 E. St. Charles Rd., Lombard, IL 60148; (800) 782-7922, (708) 627-4004.

List Price: With 2MB RAM, 40MB hard disk, 1.44MB 3.5-inch floppy disk drive, EGA supertwist backlit liquid crystal display, one parallel port, two serial ports, *LapLink* and *AlphaWorks* utilities, DR-DOS 3.40, \$4,995; with 4MB RAM, \$5,590.

In Short: The Dauphin Crown SX is a sturdy, 16-pound-plus laptop with both a built-in AC adapter and a removable lead acid battery. The Crown SX's EGA-mode LCD screen is fine for text but a bit lacking for graphics. A fully loaded Crown SX with 4MB memory and a 100MB hard disk gives you plenty of power for the road.

CIRCLE 402 ON READER SERVICE CARD

hour and 45 minutes to 2 hours, and on our tests it scored a close 1 hour and 36 minutes. Recharging takes 6 hours. Extra battery packs are \$69. The Crown SX has a dark-gray, sturdy, hard-plastic case with a molded handle. The case measures 3.25 by 12.75 by 16.25 inches (HWD).

The 75-key keyboard uses full-size keys and has a good feel. There are no separate function keys; you have to use the usual top-row number keys in conjunction with a special FN key. This is odd, since there's plenty of room on the case for a more-standard keyboard. There is a port for an external PS/2-style keyboard if that's your preference.

The Crown SX's backlit supertwist LCD high-contrast blue-on-white display is very pleasant, with minor aspect ratio flattening to 1.62. The internal display works in EGA and CGA modes, while the port for external monitors can work in CGA, EGA, or VGA modes.

The Crown SX uses AMI ROM BIOS and can have a maximum of 4MB RAM; the extra 2MB costs an additional \$595. The other option for maxing out the system is an upgrade to a 100MB hard drive for an additional \$800. An internal, 2,400-bit-per-second modem costs \$189; Dauphin

SIMPLY ELEGANT



The Genius GM-F301 mouse can satisfy your need for both kinds of elegance: aesthetic and technical. To appreciate the aesthetic side of the Genius mouse is easy – just run your eyes over its clean lines and feel its silky glide as you guide it around your desk. Nice, huh? Makes you wish you had more mouse-driven programs, doesn't it? No problem! The GM-F301 even comes with a utility to "mousify" all your software so you'll never have to take your hand off this mouse.

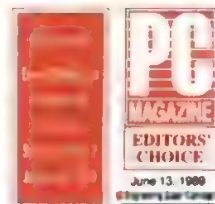
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GM-F301 is even easier. The GM-F301 is almost mindlessly simple for the novice to use and amazingly versatile for the advanced power user. It can be switched between the two mouse modes **at any time** (that's right – at **any** time) by a simple flip of a switch, plugs into Com 1 through Com 4, has three different ranges of dynamic resolution, and features X-Y lock. All this plus Genius' legendary reputation for building virtually indestructible and universally compatible mice means that the Genius GM-F301 mouse is simply the perfect choice.

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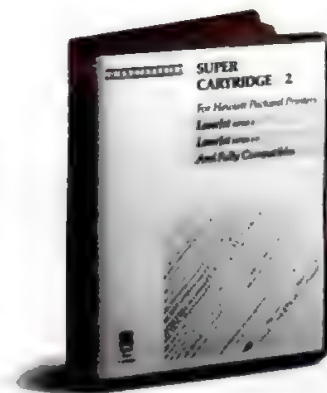
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sells several other modems, as well. A single-slot, 16-bit expansion chassis goes for \$295, and a carrying case is \$69.

The Crown SX is an attractive, sturdy laptop with convenient power options, reasonable expansion capability, and an EGA screen that's fine for text but not for graphics. For 386SX power to go, this machine deserves a close look.

DELL COMPUTER CORP.

Dell 316LT

by Bill O'Brien

The Dell Computer Corp. has been around for the longest time, and the hallmark of its equipment has always been technology that, for better or worse, continually pushed the envelope. But Dell, along with the rest of the industry, is growing up. The 316LT, Dell's spanking new laptop for the '90s, has emerged fully formed, functional, and smacking of solid—albeit conservative—technology.

The 316LT is an 80386SX laptop housed in a clamshell enclosure that runs at the stock SX speed of 16 MHz. The tested machine arrived at PC Labs with 2MB of RAM operating at zero wait states, a 40MB IDE hard disk, a 1.44MB 3.5-inch floppy disk drive, and a VGA display system outputting to a detachable backlit LCD screen. It's a \$4,099 package that weighs in at a tidy 15 pounds.

While you should never intentionally find yourself on the inside of a computer packed in a clamshell, the 316LT does have some room for expansion. I/O board compatibility is satisfied by a single 8-bit half-length slot clocking a conservative 8 MHz. There's a proprietary connector for an internal modem using MNP Level 5 protocol that will also do double duty as a fax board, and 8MB of SIMMs can be layed into the Kyocera motherboard before it reaches its capacity.

Both the VGA display and the usual Dell 83-key keyboard are excellent. A quick trip around the equator of the laptop will reveal both parallel and serial ports, as well as a socket for an external keyboard and a tap for an external VGA monitor (unfortunately, it will not do simultaneous display from the Paradise Designer 800 electronics).

But if all of this sounds as if Dell has created some pretty tame stuff, you'll be relieved to find that Dell has paid some special attention to one feature that is

PORTABLE 286 AND 386SX-BASED

sometimes taken for granted, the battery.

A little longer than a cigarette pack and just as wide, the 316LT's battery drives the machine with 10.8 volts and will normally last for about 2 hours, according to the manufacturer's specification. There's a low-battery warning light to let you know when you're about to run out power. And what happens when you do? Just pull out

the drained unit and plug in the spare (you'll get a second battery pack free for a limited time).

The trick is that you don't need to stop what you're doing when you swap the batteries: you don't need to turn off the computer; you don't need to save your application and data files. Dell has put a capacitor setup inside the 316LT that will maintain the machine in operating condition for up to 3 minutes (depending on what you're



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PORTABLES

386- AND 386SX-BASED

386- AND 386SX-BASED PORTABLES: SUMMARY OF FEATURES



	Compaq Portable 386	Data World Data LP/SX	Data World Portacomp 386-20	Dauphin Crown SX	 Dell 316LT	Dolch P.A.C. 386-20	 Dolch P.A.C. 386-25C
ADD-IN MEMORY BOARD							
Installed RAM	None	4MB	N/A	N/A	N/A	N/A	N/A
Maximum installable RAM	8MB	4MB	N/A	N/A	N/A	N/A	N/A
RAM packaging and rated speed	SIMM (80 ns.)	DIP (100 ns.)	N/A	N/A	N/A	N/A	N/A
Chip size	1Mb	4 x 256Kb	N/A	N/A	N/A	N/A	N/A
BIOS							
BIOS version and date	Compaq K3 (November 1988)	AMI 386 1.1 (April 1989)	AMI 3.1a (April 1989)	AMI 033089-K8 (March 1989)	Phoenix 1.1 A00 (November 1989)	AMI DC2T 5006 (April 1989)	Quadtel 3.03.03 (August 1989)
Password in ROM	☐	☐	☐	☐	☐	☐	☐
Video shadowing	☒	☒	☒	☐	☒	☒	☒
System shadowing	☒	☐	☒	☐	☐	☒	☒
COPROCESSOR							
Coprocessor supported	80387-20, 20-MHz Weitek 3167	80387SX-16	80387-20, 20-MHz Weitek 1167	80387SX-16	80387SX-16	80387-20	80387-25
Supports 387 and Weitek coprocessors simultaneously	☐	N/A	☐	N/A	N/A	N/A	N/A
HARD DISK							
Manufacturer	Conner	Conner	Conner	Conner	Conner	Toshiba	NEC
Disk capacity	110MB	104MB	104MB	40MB	20MB	45MB	153MB
Interface	ST-506	IDE	IDE	IDE	IDE	ST-506	ESDI
Average access time (milliseconds)	25	28	28	28	28	25	18
Controller manufacturer	Compaq	Conner	Conner	Conner	Conner	National Computer	Adaptec
Hard disk options	None	43MB, 104MB SCSI	43MB, 104MB SCSI	100MB IDE	40MB IDE	100MB, 150MB ESDI; 100MB, 170MB SCSI	40MB ST-506; 100MB ESDI; 100MB, 170MB SCSI
INTERNAL FLOPPY DISK DRIVE							
Capacity	1.2MB	1.44MB	1.44MB	1.44MB	1.44MB	1.2MB	1.44MB
Size	5.25-inch	3.5-inch	3.5-inch	3.5-inch	3.5-inch	5.25-inch	3.5-inch
Manufacturer	Mitsubishi	Epson	Sony	Sony	Sony	TEAC	Toshiba
EXPANSION							
Bus speeds (MHz)	8	8	8	8, 12	8	6.7, 8, 10	8.3, 10, 12.5
Expansion slots	None	One 16-bit	Two 8-bit, four 16-bit, one proprietary	One proprietary	One 8-bit, one proprietary	One 8-bit, seven 16-bit	Six 16-bit, two 32-bit
Available slots	N/A	1	2	1	2	2	3
Drive bays	3 half-height, 1 one-third height	2 half-height	2 half-height	2 half-height	2 half-height	2 half-height	2 half-height
VIDEO							
Display circuitry location	Card	Motherboard	Card	Motherboard	Motherboard	Card	Card
Interface	8-bit	16-bit	8-bit	16-bit	16-bit	8-bit	8-bit
Chip set manufacturer	Paradise	Cirrus	Gemini	Chips and Technologies	Chips and Technologies	Paradise	Paradise
Video modes supported	EGA, CGA, MDA	VGA, EGA, CGA, MDA	EGA, CGA, MDA	EGA, CGA, MDA	VGA, EGA, CGA, MDA	VGA, EGA, CGA, MDA	VGA, EGA, CGA, MDA
Viewable area (WxH, in inches)	8.3 x 5.2	9 x 6	8.25 x 5.5	8.88 x 5.5	7.8 x 5.8	9 x 6.9	9 x 6.9
Supports internal and external displays simultaneously	☐	☒	☒	☐	☐	☒	☒

☒ —Editor's Choice ☒ —Yes ☐ —No

N/A—Not applicable: the product does not have this feature.

PORTABLES

386- AND 386SX-BASED

GRIDCase 1530	GRIDCase 1535 EXP	IBM PS/2 Model P70 386	Blue Max Attache 386	Maxtron LCD Portable 386	Micro Express Regal SX	Micro Express Regal II	Micro Telestar 386 Portable
N/A	N/A	N/A	N/A	N/A	N/A	4MB	None
N/A	N/A	N/A	N/A	N/A	N/A	8MB	8MB
N/A	N/A	N/A	N/A	N/A	N/A	DIP (80 ns.)	SIP (100 ns.)
N/A	N/A	N/A	N/A	N/A	N/A	1Mb	256Kb, 1Mb
Phoenix 3.06 (July 1988)	Phoenix 3.06 (March 1989)	IBM (January 1989)	AMI 3607 (April 1989)	AMI 3601 (March 1989)	Phoenix N1.10.12 (January 1988)	AMI 3606-K3 (April 1989)	AMI 3601 (March 1989)
■	■	■	□	□	□	□	□
□	□	□	■	■	■	■	■
□	□	■	■	■	■	■	■
80387-16	80387-16	80387-20	80387-33, 33-MHz Weitek 1167	80387-25	80386SX-16	80387-25	80287-10, 80387-20, 20-MHz Weitek 1167
N/A	N/A	N/A	■	N/A	N/A	N/A	□
Conner 20MB ST-506 28 GRiD	Conner 43MB ST-506 28 GRiD	IBM 122MB Proprietary 24 IBM	Imprimis 186MB ESDI 28 DPT	Toshiba 44MB ST-506 25 NDC	CDC 157MB ESDI 15 DTC	CDC 157MB ESDI 15 DTC	Seagate 84MB SCSI 30 Seagate
40MB, 100MB ST-506	40MB MFM	60MB proprietary	Varies with dealer	150MB ESDI; 80MB, 150MB SCSI	40MB ST-506; 100MB ESDI	40MB ST-506; 100MB ESDI	30MB, 40MB, 60MB ST-506; 120MB, 150MB ESDI; 200MB SCSI
1.44MB 3.5-inch Epson	N/A N/A N/A	1.44MB 3.5-inch Sony	1.2MB, 1.44MB 5.25-, 3.5-inch Fujitsu	1.44MB 3.5-inch TEAC	1.44MB 3.5-inch Matsushita	1.44MB 3.5-inch Matsushita	1.2MB 5.25-inch PC III
8 None	8 None	10 One 16-bit, one 32-bit	8 Two 8-bit, six 16-bit, one 32-bit	10 Three 8-bit, four 16-bit, one 32-bit	8, 10, 12 One 8-bit, four 16-bit, one 32-bit	8 One 8-bit, six 16-bit, one 32-bit	8 Two 8-bit, four 16-bit, one 32-bit
None 2 half-height	None 2 half-height	2 2 proprietary	2 2 half-height	4 2 half-height	2 2 half-height	0 2 half-height	5 2 half-height
Motherboard 8-bit Yamaha	Motherboard 8-bit Yamaha	Motherboard 16-bit IBM	Card 8-bit Tseng Labs	Card 8-bit Yamaha	Card 8-bit Gemini	Card 8-bit Gemini	Card 8-bit Prisma
CGA, MDA	CGA, MDA	VGA, EGA, CGA, MDA	CGA, MDA	EGA, CGA, MDA	EGA, CGA, MDA	EGA, CGA, MDA	EGA, CGA, MDA
8.75 x 5.75 □	8 x 5 □	8.4 x 7.25 □	7 x 5.75 ■	9.1 x 5.8 □	8.25 x 5.25 □	8.25 x 5.25 □	8.25 x 5.1 □

CONTINUES



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386- AND 386SX-BASED PORTABLES: SUMMARY OF FEATURES

	National Micro Systems Gas Plasma 386SX-16	National Micro Systems Gas Plasma 386-25	NEC PowerMate Portable SX	NEC ProSpeed CSX Color Laptop Computer	NEC ProSpeed 386 Laptop Computer	Pan United Micro Labs 386/20L	PC Brand 386/SX-16 Portable III
INTERNAL FLOPPY DISK DRIVE							
Capacity	1.2MB	1.2MB	1.44MB	1.2MB, 1.44MB	1.44MB	1.2MB	1.2MB, 1.44MB
Size	5.25-inch	5.25-inch	3.5-inch	5.25-, 3.5-inch	3.5-inch	5.25-inch	5.25-, 3.5-inch
Manufacturer	Fujitsu	Fujitsu	NEC	NEC	TEAC	TEAC	TEAC, Toshiba
EXPANSION							
Bus speeds (MHz)	8	8, 10, 12	8	8	8	8	8, 16
Expansion slots	Two 8-bit, five 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit	Three 16-bit	Two proprietary	Three proprietary	One 8-bit, four 16-bit, one 32-bit	Three 8-bit, five 16-bit
Available slots	2	1	3	N/A	3	0	1
Drive bays	3 half-height	2 half-height	2 half-height	2 half-height	2 half-height	3 half-height	3 half-height
VIDEO							
Display circuitry location	Card	Card	Motherboard	Motherboard	Motherboard	Card	Card
Interface	8-bit	8-bit	8-bit	16-bit	8-bit	16-bit	16-bit
Chip set manufacturer	Yamaha	Yamaha	Paradise	Chips and Technologies	Chips and Technologies	Ahead Tech	Trident
Video modes supported	CGA, MDA	CGA, MDA	VGA, EGA, CGA, MDA	EGA, CGA, MDA	EGA, CGA, MDA	VGA, EGA, CGA, MDA	VGA, EGA, CGA, MDA
Viewable area (WxH, in inches)	8.3 x 5.1	8.3 x 5.1	8.3 x 5.25	8.5 x 5.25	5.6 x 9.0	8.25 x 6.25	7.75 x 5.9
Supports internal and external displays simultaneously	☐	☐	☒	☐	☒	☒	☒
KEYBOARD							
Number of keys	86	86	93	89	92	101	86
Number of function keys	12	12	12	12	12	12	12
Keyboard cable length (inches)	18	18	58	N/A	N/A	24	18
SOFTWARE AVAILABLE							
OS/2	None	None	1.0 (\$325)	1.0 (\$325)	1.0 (\$325)	None	None
Disk caching software	☐	☐	☐	☐	☐	☐	☐
Expanded memory manager	☐	☐	☐	☐	☐	☐	☐
PHYSICAL FEATURES							
Power supply (watts)	180	180	130	60	40	150	180
Switchable power supply	☒	☒	☒	☒	☒	☒	☒
Number of device connectors	4	3	2	1	3	3	4
Keyboard lock	None	None	None	None	None	None	None
Case lock	None	None	None	Front	None	None	None
Power-on switch	Back	Back	Side	Side	Side	Back	Back
Reset switch	Front	Front	Side	Side	Side	None	Front
BATTERY							
Battery type	N/A	N/A	N/A	N/A	Removable	N/A	N/A
Battery material	N/A	N/A	N/A	N/A	Nickel cadmium	N/A	N/A
Claimed battery life	N/A	N/A	N/A	N/A	1-2.5 hours	N/A	N/A
Battery charge time	N/A	N/A	N/A	N/A	12 hours	N/A	N/A
Battery voltage and Amp/hours	N/A	N/A	N/A	N/A	12V, 4.5Ah	N/A	N/A
Battery conservation techniques	N/A	N/A	N/A	N/A	Display and disk shutdown	N/A	N/A
Transformer weight (lbs.)	N/A	N/A	N/A	N/A	Built-in	N/A	N/A
Transformer size (inches)	N/A	N/A	N/A	N/A	Built-in	N/A	N/A
Car battery adapter available	N/A	N/A	N/A	N/A	☒	N/A	N/A
OPTIONS							
External floppy disk drives	☐	☐	☒	☒	☒	☐	☐
Capacity	N/A	N/A	1.2MB	1.2MB	1.2MB	N/A	N/A
Size	N/A	N/A	5.25-inch	5.25-inch	5.25-inch	N/A	N/A

☐—Editor's Choice ☒—Yes ☐—No

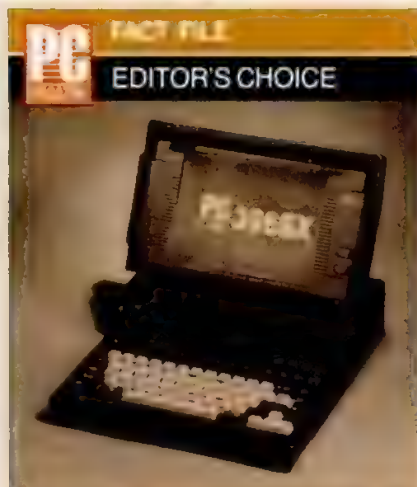
N/A—Not applicable: the product does not have this feature.

PORTABLES

386- AND 386SX-BASED

PC Brand 386/20 Portable III	PC Brand 386/25 Portable III	Tangent 386/25 Portable	Toshiba T3100SX	Toshiba T3200SX	Toshiba T5100/100	Toshiba T5200/100	Zenith SupraPort SX
1.2MB, 1.44MB 5.25-, 3.5-inch TEAC, Toshiba	1.2MB, 1.44MB 5.25-, 3.5-inch TEAC, Toshiba	1.44MB 3.5-inch TEAC	1.44MB 3.5-inch Toshiba	1.44MB 3.5-inch Toshiba	1.44MB 3.5-inch Toshiba	1.44MB 3.5-inch Toshiba	1.44MB 3.5-inch Matsushita
6.7, 8, 10, 20 Three 8-bit, five 16-bit 1 3 half-height	8, 12.5, 25 Three 8-bit, five 16-bit 1 3 half-height	12 Two 8-bit, four 16-bit, two 32-bit 2 2 half-height, 2 one-third height	16 Two proprietary 2 2 half-height	8, 10 One 8-bit, one 16-bit, two proprietary 3 2 half-height	16 One proprietary 0 2 half-height	8 One 8-bit, one 16-bit, two proprietary 2 2 half-height	8, 16 None 0 2 half-height
Card 16-bit Trident	Card 16-bit Trident	Card 8-bit Wang	Motherboard 16-bit Paradise	Motherboard 16-bit Paradise	Motherboard 16-bit Paradise	Motherboard 16-bit Paradise	Motherboard 16-bit Zenith
VGA, EGA, CGA, MDA 7.75 x 5.9	VGA, EGA, CGA, MDA 7.75 x 5.9	EGA, CGA, MDA 8.25 x 5.25	VGA, EGA, CGA, MDA 7.75 x 5.9	VGA, EGA, CGA, MDA 9 x 6.75	EGA, CGA, MDA 7.6 x 6	VGA, EGA, CGA, MDA 9 X 6.8	VGA, EGA, CGA, MDA 8.25 x 6.25
86 12 18	86 12 18	102 12 24	86 10 N/A	91 12 N/A	82 10 N/A	91 12 N/A	79 10 N/A
None □ □	None □ □	None □ □	1.0 (\$325) ■ ■	1.1 (\$325) ■ ■	1.0 (\$325) ■ ■	1.1 (\$325) ■ ■	1.1 (\$339) □ ■
180 ■ 4 None None Back Front	180 ■ 4 None None Back Front	150 ■ 2 None None Back None	60 ■ N/A None None Side Side	172 ■ N/A None None Back Side	175 ■ N/A None None Back None	207 ■ N/A Front Front Back None	Info. not available ■ N/A None None Side None
N/A N/A N/A N/A N/A N/A	N/A N/A N/A N/A N/A N/A	N/A N/A N/A N/A N/A N/A	Removable Nickel cadmium 3 hours 3 hours 9.6V, 2.4Ah Display and disk shutdown, resume feature	N/A N/A N/A N/A N/A N/A	N/A N/A N/A N/A N/A N/A	N/A N/A N/A N/A N/A N/A	Removable Nickel cadmium 3 hours 3 hours 12V, 4Ah Display and disk shutdown
N/A N/A N/A	N/A N/A N/A	N/A N/A N/A	1.7 3 x 6.8 x 2.25 □	N/A N/A N/A	N/A N/A N/A	N/A N/A N/A	1.6 3 x 6.25 x 2 ■
□ N/A N/A	□ N/A N/A	■ 1.2MB, 1.44MB 5.25-, 3.5-inch	■ 360K 5.25-inch	■ 360K 5.25-inch	■ 360K 5.25-inch	■ 360K 5.25-inch	■ 360K 5.25-inch

CONTINUES



Dell 316LT

Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759-7299; (800) 426-5150, (512) 338-4400.

List Price: With 1MB RAM, 20MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA liquid crystal display, one parallel, one serial port, DOS 3.3, \$3,598.95; with 2MB RAM, 40MB hard disk, \$4,099.

In Short: Solid performance, light weight, and intelligent battery design make this 16-MHz 386SX-based clamshell stand out from the crowd.

CIRCLE 423 ON READER SERVICE CARD

doing) with the battery completely removed.

Each battery pack will recharge within 8 hours in trickle mode, which provides a deep charge, but there's also a fast charge mode that will top off your depleted power pack in 2 hours. And to keep your batteries from running down if you leave the machine unattended, you can set an inactivity timer that will turn off the screen when your preset time interval has elapsed. If you'll be away from the computer but don't want to shut it off completely, there's even a standby switch that will maintain power to the processor and memory but will turn everything else off.

Full of Dell workmanship, the battery pack is an excellent adjunct to the 316LT's already rock steady performance, making it a strong contender for your serious consideration. Add in the low-weight factor, and this just might be the portable you can live with.

DOLCH COMPUTER SYSTEMS

Dolch P.A.C. 386-20

by M. David Stone

The Dolch P.A.C. 386-20 has almost the same name as the P.A.C. 386-20C that earned an Editor's Choice in the October

PORTABLES 386 AND 386SX-BASED

11, 1988, issue of *PC Magazine*. But the missing C is significant. The C stands for Cache, which the \$8,135 P.A.C. 386-20 doesn't have. While this model can't match the 386-20C's performance, it does offer quality construction and careful attention to detail.

The tested unit is a 21-pound lunchbox with a gas plasma display, 2MB of 80-nanosecond RAM in SIP modules, a 20-MHz 80387 coprocessor, a 40MB 25-millisecond Toshiba hard disk, one 5.25-inch 1.2MB floppy disk drive, a Paradise VGA Plus card, one serial and one parallel port, a one-year parts-and-labor warranty, and DOS 3.3 or 4.01.

If eight grand seems like a lot, remember that you can wind up spending over \$10,000 on the P.A.C. 386-20 by adding extra memory or a larger disk drive. You can replace the 45MB hard disk drive with a 100MB version for an additional \$1,595, with a 150MB drive for \$1,795, or a 170MB drive for \$1,995. You can cut \$895 from the price if you don't need the math coprocessor, and you can save \$595 by getting the electroluminescent display rather than the gas plasma model.

But if you're going to pay this much for a system, you might as well go first class, especially when it comes to the display. Text readability is among the best available on a gas plasma display. On the PC Labs tests, the display showed 16 shades of gray. As expected, this translated to an unrecognizable image for the 64-color picture; however, it produced a perfectly acceptable image for the 16-shade picture.

Also worth special mention is the Cherry keyboard, which has an exceptionally good feel. Unfortunately, it follows the original AT layout, except that the function keys are across the top. For those who use both the original AT and enhanced keyboards, this hybrid design is potentially confusing.

The inside of the P.A.C. 386-20 is as well designed as the outside. The Monolithic Systems motherboard sports the Chips and Technologies chip set, AMI ROM BIOS, and room for up to 8MB RAM in SIP modules. However, 8MB on the motherboard is the maximum for 32-bit RAM, since there are no additional 32-bit slots.

As with many lunchbox portables, some of the motherboard's eight slots are covered by the power supply, and some are limited to short cards because of the lo-



Dolch P.A.C. 386-20

Dolch Computer Systems, 2029 O'Toole Ave., San Jose, CA 95131; (800) 538-7506, (408) 435-1881 (in Calif.).

List Price: With 2MB RAM, 45MB hard disk, one 1.2MB 5.25-inch floppy disk drive, CGA electroluminescent display, one parallel port, one serial port, \$6,495; with DOS 3.3 or 4.01, \$6,645; with VGA gas plasma display, 80387 20-MHz coprocessor, \$8,135.

In Short: The Dolch P.A.C. 386-20 offers full-length expansion slots, a highly readable screen, and a superb keyboard—all at a premium. If expandability and quality construction are more important to you than speed, give this one a look.

CIRCLE 403 ON READER SERVICE CARD

cation of the disk drives. But Dolch has managed to find a 200-watt power supply that covers only two of the slots, leaving six 16-bit slots available. Three of these can handle a full-length card.

Our review system filled the three short slots with the Paradise VGA Plus card, a National Computer disk controller card, and an Everex parallel/serial card with one parallel and one serial connector. The three remaining full-length slots provide ample room for additional boards.

Alas, the PC Labs benchmark tests proved the P.A.C. 386-20 be a somewhat worse-than-average performer. And given the system's high price, you can easily get better performance for less. Clearly, the P.A.C. 386-20 has much going for it, but quality construction and expandability may not be enough to justify its premium price and less-than-spectacular performance.

DOLCH COMPUTER SYSTEMS

Dolch P.A.C. 386-25C

by M. David Stone

The Dolch P.A.C. 386-25C looks just like the P.A.C. 386-20, its slower, less-expensive sibling (also reviewed here). But

No matter which of these modes you use,

40-column CGA Text
40-column EGA Text
40-column VGA Text
80-column CGA Text
80-column EGA Text
80-column VGA Text
Lo-res CGA Graphics
Hi-res CGA Graphics
MDA Monochrome Text
80-column VGA Monochrome Text
Lo-res MCGA Graphics
Lo-res VGA Graphics
Med-res VGA Graphics
EGA Monochrome Graphics
Hi-res EGA Graphics
Hi-res MCGA Graphics
Hi-res VGA Graphics

we have the VGA display for it.



Magnavox introduces two new Professional Series displays that are fully compatible with all 17 VGA modes—both designed with the intelligence you've come to expect from Magnavox.

With a VGA display system, you'll get the most out of your present software and prepare yourself for graphics environments like Windows 386, OS/2,[™] and Presentation Manager.[™] Resolutions include 720 x

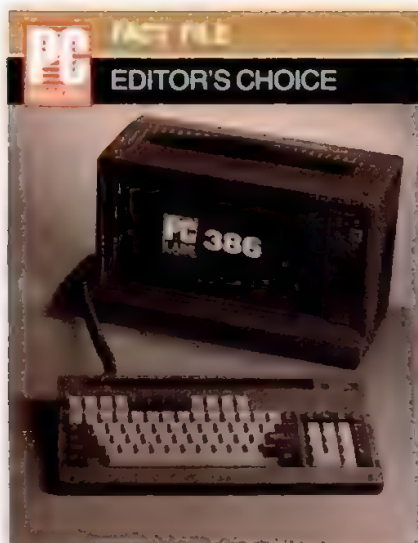
400 for text, and 640 x 480 in 256 colors for graphics.

Both displays have a 14" CRT, versus the 12" industry standard. And both come with a built-in tilt/swivel base and are backed by a 2-year limited warranty—twice as long as most other brands.

At \$229 for the 7BM749 paper-white monochrome and \$649 for the 9CM082 color display, Magnavox makes VGA displays affordable.

MAGNAVOX

Smart. Very smart.



Dolch P.A.C. 386-25C

Dolch Computer Systems, 2029 O'Toole Ave., San Jose, CA 95131; (800) 538-7506, (408) 435-1881 (in Calif.).

List Price: With 2MB RAM, 40MB hard disk, one 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, CGA electroluminescent display, one parallel port, one serial port, \$7,995; with DOS 3.3 or 4.01, \$8,145; with 153MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA gas plasma display, 25-MHz 80387 coprocessor, \$11,830.

In Short: The Dolch P.A.C. 386-25C offers just about everything: high-quality construction, a highly readable VGA gas plasma screen, a superb keyboard, three empty slots for expansion, and the best overall performance of any system tested.

CIRCLE 404 ON READER SERVICE CARD

don't let looks fool you. The 386-25C differs in one measurable detail: performance.

Quite simply, the \$11,830 Dolch P.A.C. 386-25C is the fastest overall performer of any portable in our test group. Expensive? Sure. But included in this price is a gas plasma display, 2MB of RAM, a 25-MHz 80387 coprocessor, an 18-millisecond 153MB hard disk, a 1.44MB 3.5-inch floppy disk drive, a Paradise VGA Plus card, one serial and one parallel port, DOS 4.01, and a one-year parts-and-labor warranty.

As with the 386-20, you also can buy a 100MB drive for \$1,595 or a 170MB drive for \$1,995. And as with the 386-20, the math coprocessor (\$1,295) and gas plasma display (\$595) are optional.

The 386-25C's chassis is identical to the 386-20's, measuring 10 by 15.75 by 8.25 inches (HWD). The two systems also share the same highly readable, 16-shades-of-gray gas plasma display and the same Cherry keyboard. The 386-25C weighs in at about 22.33 pounds—just a bit heavier than the 386-20.

The difference between the systems is

PORTABLES 286 AND 386SX-BASED

on the motherboards. The 386-25C's Monolithic Systems motherboard includes a Chips and Technologies 8231 cache controller and 32K of 25-nanosecond RAM cache—the feature that's largely responsible for the system's exceptional performance.

Also on the motherboard are the Chips and Technologies chip set, Quadtel BIOS, and room for up to 8MB of SIP-mounted RAM. The 2MB of SIPs on our review unit used 80-nanosecond, 256K chips. Two 32-bit slots can accept proprietary memory boards with up to 8MB each, for a system total of 24MB.

Beyond the motherboard, the inside of the 386-25C looks much like the 386-20. Here again, two of the eight slots are covered by the 200-watt power supply, and three slots are limited to short cards because of the disk drives.

In the review system, two of the short slots were filled with the Paradise VGA Plus card and an Everex parallel/serial card, with one parallel and one serial connector. The Adaptec disk controller, with 16K of disk-cache RAM on-board, takes up a full-length slot.

Still available for expansion are one short slot and the two full-length 32-bit slots, which can also be used for 8- or 16-bit boards. If you need more expansion, Dolch sells an \$895 expansion chassis with three 16-bit slots and its own 200-watt power supply.

The P.A.C. 386-25C proved itself a speed demon on the PC Labs benchmark tests, achieving the fastest times in most tests and close to the fastest in others. Those results give it an uncommon combination of solid design, quality construction, and top performance.

What we said of the P.A.C. 386-25C in the December 12, 1989, issue, still stands: for those who want desktop speed and power with the compactness of a portable, the Dolch P.A.C. 386-25C can't be beat.

GRID SYSTEMS CORP.

GRiDCase 1530

by Mitt Jones

When it was introduced in October of 1987, the GRiDCase 1530 was hot stuff. Two years later, about all the 1530 has going for it are its wealth of options and



GRiDCase 1530

GRiD Systems Corp., 47211 Lakeview Blvd., P.O. Box 5003, Fremont, CA 94537-5003; (800) 222-GRID, (415) 656-4700.

List Price: With 1MB RAM, two 1.44MB 3.5-inch floppy disk drives, CGA liquid crystal display, one parallel, one serial port, \$4,695; with 2MB RAM, 40MB hard disk, utilities, DOS 3.3, \$7,115; with 1MB RAM, 20MB hard disk, one 1.44MB 3.5-inch floppy disk drive, CGA gas plasma display, 2,400-bps internal modem, 80387/16 coprocessor, \$8,605.

In Short: A sleek, solidly-built 386 laptop burdened by numerous flaws. Advantages include an unusual range of options and a removable internal battery pack. Flaws include a miserable keyboard layout, overly hot power pack, poor CGA gas plasma screen, and 12.5-MHz speed.

CIRCLE 405 ON READER SERVICE CARD

GRiD-given good looks. Despite its 16MHz processor, the 386-based 1530 runs at a top speed of 12.5 MHz, undoubtedly in order to conserve precious battery power. The lowered speed tends to take the snap out of 386 computing. Loaded with a 40MB hard disk, 2MB of RAM, CGA gas plasma display, and DOS 3.3 standard, the \$7,115 1530 costs more than some 386 portables but strolls along at the leisurely pace of some 286 machines.

And, at a time when sharp, double-scan CGA screens barely cut it on a 6-pound notebook laptop, our 1530 was saddled with a marginal, 640 by 400 CGA display. To its credit, the screen boasts bright orange characters against a background that is truly black—a rarity with gas-plasma displays. But the characters are poorly formed, and the display generates its four gray-scales using hatch patterns that are difficult on the eyes, especially when viewed for long periods. GRiD reports that a supertwist LCD VGA display is now available as an option and, indeed, the 286-based, GRiDCase 1520 reviewed in this blockbuster does sport such a creature. Instinct on the LCD display.

The 1530's battery pack would seem to

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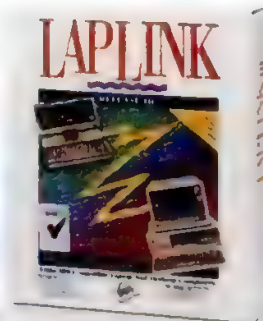
Battery Watch II also supports most of today's popular laptop brands.

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M.S.R.P. \$149.95



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CIRCLE 223 ON READER SERVICE CARD



386- AND 386SX-BASED PORTABLES: SUMMARY OF FEATURES

	Compaq Portable 386	Data World Data LP/SX	Data World Portacomp 386-20	Dauphin Crown SX	Dell 316LT	Dolch P.A.C. 386-20	Dolch P.A.C. 386-25C
KEYBOARD							
Number of keys	91	85	102	75	83	86	86
Number of function keys	12	10	12	12	12	12	12
Keyboard cable length (inches)	30	N/A	34.5	N/A	N/A	25.5	25.5
SOFTWARE AVAILABLE							
OS/2	1.1, 1.2 (\$340)	None	None	None	1.1 (\$299)	None	None
Disk caching software	■	□	□	□	□	□	□
Expanded memory manager	■	■	■	■	□	□	□
PHYSICAL FEATURES							
Power supply (watts)	145	85	150	40	53	200	200
Switchable power supply	■	■	■	■	■	■	■
Number of device connectors	2	N/A	4	N/A	N/A	2	2
Keyboard lock	None	None	None	None	None	None	None
Case lock	None	None	None	None	None	None	None
Power-on switch	Back	Back	Back	Back	Side	Back	Back
Reset switch	None	Front	Side	None	Side	Front	Front
BATTERY							
Battery type	N/A	N/A	N/A	Removable	Removable	N/A	N/A
Battery material	N/A	N/A	N/A	Lead acid	Nickel cadmium	N/A	N/A
Claimed battery life	N/A	N/A	N/A	2 hours	2 hours	N/A	N/A
Battery charge time	N/A	N/A	N/A	6 hours	2 hours	N/A	N/A
Battery voltage and Amp/hours	N/A	N/A	N/A	12V, 4Ah	10.8V, 2.4Ah	N/A	N/A
Battery conservation techniques	N/A	N/A	N/A	Display and disk shutdown	Sleep mode, stand by button	N/A	N/A
Transformer weight (lbs.)	N/A	N/A	N/A	Built-in	2.7	N/A	N/A
Transformer size (inches)	N/A	N/A	N/A	Built-in	3.9 x 9.4 x 3.1	N/A	N/A
Car battery adapter available	□	■	□	■	□	□	□
EXTERNAL DEVICES							
External floppy disk drives	□	■	■	■	■	□	□
Capacity	N/A	1.2MB	1.2MB	360K, 1.2MB	1.2MB	N/A	N/A
Size	N/A	5.25-inch	5.25-inch	5.25-inch	5.25-inch	N/A	N/A
Modems (bits per second)	1,200, 2,400	2,400	2,400	1,200, 2,400, 4,800, 9,600	2,400	None	None
Error correction	None	None	None	MNP Level 5	None	N/A	N/A
Expansion chassis	■	□	□	■	□	■	■
Bus speed (MHz)	8	N/A	N/A	16	N/A	6.7, 8, 10	8.3, 10, 12.5
Expansion slots	Two 16-bit	N/A	N/A	One 16-bit, one proprietary	N/A	Three 16-bit	Three 16-bit
Docking station	□	□	□	□	□	□	□
Bus speed (MHz)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion slots	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CONNECTIVITY							
Topology of available network cards	None	Ethernet	Ethernet	None	Ethernet	None	None
Third-party network cards available	■	■	■	■	□	■	■
Distribution (dealer or direct)	Dealer	Direct	Direct	Both	Direct	Both	Both
Warranty	1 year	1 year	1 year	1 year	1 year	1 year	1 year
Service	Return to dealer	Ship to manufacturer	Ship to manufacturer	Ship to manufacturer or return to dealer	On-site	Ship to manufacturer	Ship to manufacturer
FCC certification	B	A	A	B	B	A	A

■ —Editor's Choice ■ —Yes □ —No

N/A—Not applicable: the product does not have this feature.

PORTABLES
386- AND 386SX-BASED

GRIDCase 1530	GRIDCase 1535 EXP	 IBM PS/2 Model P70 386	Blue Max Attache 386	Maxtron LCD Portable 386	Micro Express Regal SX	Micro Express Regal II	Micro Telestar 386 Portable
72	72	101	84	86	102	102	86
10	10	12	10	12	12	12	12
N/A	N/A	18	20	18	24	24	16
None	None	1.2 (\$325)	None	None	1.1 (\$275)	1.1 (\$275)	None
☐	☐	☒	☐	☐	☐	☐	☐
☒	☒	☒	☐	☐	☐	☐	☐
60	60	85	150	200	180	180	220
☒	☒	☒	☒	☒	☒	☒	☒
None	None	None	3	4	4	4	3
None	None	None	Side	None	None	None	None
None	None	None	None	None	None	None	None
Back	Back	Front	Side	Back	Back	Back	Back
None	None	None	Side	Front	Side	Side	Front
Removable	Removable	N/A	N/A	N/A	N/A	N/A	N/A
Nickel cadmium	Nickel cadmium	N/A	N/A	N/A	N/A	N/A	N/A
0.5-1.5 hours	0.5-1.5 hours	N/A	N/A	N/A	N/A	N/A	N/A
12 hours	12 hours	N/A	N/A	N/A	N/A	N/A	N/A
10.8V, 1.7Ah	10.8V, 1.7Ah	N/A	N/A	N/A	N/A	N/A	N/A
Display and disk shutdown	Display and disk shutdown	N/A	N/A	N/A	N/A	N/A	N/A
1.14	1.14	N/A	N/A	N/A	N/A	N/A	N/A
2.9 x 5.8 x 1.4	2.9 x 5.8 x 1.4	N/A	N/A	N/A	N/A	N/A	N/A
☒	☒	N/A	N/A	☒	N/A	N/A	N/A
☒	☒	☒	☐	☐	☒	☒	☒
360K, 1.2MB, 1.44MB	360K, 1.2MB, 1.44MB	1.2MB	N/A	N/A	1.2MB	1.2MB	1.44MB
5.25-, 3.5-inch 2,400	5.25-, 3.5-inch 2,400	5.25-inch 2,400	N/A None	N/A 2,400	5.25-inch 2,400	5.25-inch 2,400	3.5-inch 2,400
MNP Level 5	MNP Level 5	MNP Level 5	N/A	MNP Level 5	None	None	None
☒	☒	☐	☐	☐	☐	☐	☐
8	8	N/A	N/A	N/A	N/A	N/A	N/A
Five 8-bit	Five 8-bit	N/A	N/A	N/A	N/A	N/A	N/A
☐	☒	☐	☐	☐	☐	☐	☐
N/A	8	N/A	N/A	N/A	N/A	N/A	N/A
N/A	One 8-bit, one 16-bit	N/A	N/A	N/A	N/A	N/A	N/A
Ethernet	Ethernet	Ethernet	Arctnet, Ethernet	Ethernet	Ethernet	Ethernet	None
☐	☒	☒	☒	☒	☒	☒	☒
Both 1 year Return to dealer	Both 1 year Return to dealer	Dealer 1 year Return to dealer	Both 1 year Ship to manufacturer	Dealer 1 year Ship to manufacturer	Direct 15 months On-site	Direct 15 months On-site (4 months), then ship to manufacturer	Direct 13 months Ship to manufacturer
A	A	B	A	A	A	B	A

CONTINUES



386- AND 386SX-BASED PORTABLES: SUMMARY OF FEATURES

	National Micro Systems Gas Plasma 386SX-16	National Micro Systems Gas Plasma 386-25	NEC PowerMate Portable SX	NEC ProSpeed CSX Color Laptop Computer	NEC ProSpeed 386 Laptop Computer	Pan United Micro Labs 386/20L	PC Brand 386/SX-16 Portable III
OPTIONS							
Modems (bits per second)	2,400	2,400	None	2,400	2,400	2,400	1,200, 2,400
Error correction	None	None	N/A	None	MNP Level 5	None	MNP Level 5
Expansion chassis	☐	☐	☐	☐	☐	☐	☐
Bus speed (MHz)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion slots	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Docking station	☐	☐	☐	☐	☒	☐	☐
Bus speed (MHz)	N/A	N/A	N/A	N/A	8	N/A	N/A
Expansion slots	N/A	N/A	N/A	N/A	One 8-bit, three 16-bit	N/A	N/A
CONNECTIVITY							
Topology of available network cards	None	None	None	None	Ethernet, StarLAN	Arcnet	Arcnet, Ethernet
Third-party network cards available	☒	☐	☒	☐	☒	☒	☒
MISCELLANEOUS							
Distribution (dealer or direct)	Direct	Direct	Dealer	Dealer	Dealer	Both	Direct
Warranty	1 year	1 year	1 year	1 year	1 year	1 year	1 year
Service	Ship to manufacturer	Ship to manufacturer	Return to dealer	Ship to manufacturer	Ship to manufacturer	Ship to manufacturer	On-site
FCC certification	A	B	B	B	B	A	A

—Editor's Choice
 ☒ —Yes
 ☐ —No

N/A—Not applicable: the product does not have this feature.

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Corp.

Stafford Kissell & Paulsworth

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N
A
L**

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Street Address

City, State, Zip

Have you ever ap

Position Desired?

Apart from abeen

☐ Yes ☐ No

Are you legally el

Other special trait

How did you learn

PORTABLE 386 AND 386X-BASED

PC Brand 386/25 Portable III	PC Brand 386/25 Portable III	Tangent 386/25 Portable	Toshiba T3100SX	Toshiba T3200SX	Toshiba T5100/100	Toshiba T5200/100	Zenith SupersPort SX
1,200, 2,400	1,200, 2,400	2,400, 9,600, 19,200	2,400	300, 1,200, 2,400	300, 1,200	300, 1,200, 2,400	2,400
MNP Level 5	MNP Level 5	MNP Level 5	None	None	None	None	None
☐	☐	☐	☐	☐	☐	☐	☐
N/A	N/A	N/A	8	8	8, 16	8, 10	8
N/A	N/A	N/A	Five 8-bit	Five 8-bit	Six 8-bit	Five 8-bit	Three 8-bit
☐	☐	☐	☐	☐	☐	☐	☐
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Arcnet, Ethernet	Arcnet, Ethernet	Ethernet, Token-Ring	Ethernet, Token-Ring	Ethernet, Token-Ring	Ethernet, Token-Ring	Ethernet, Token-Ring	N/A
☐	☐	☐	☐	☐	☐	☐	☐
Direct	Direct	Both	Dealer	Dealer	Dealer	Dealer	Dealer
1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year
On-site	On-site	Ship to manufacturer	Ship to manufacturer or return to dealer	Ship to manufacturer or return to dealer	Ship to manufacturer or return to dealer	Ship to manufacturer or return to dealer	Return to dealer
A	A	A	B	B	B	B	B

ENDS

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CIRCLE 235 ON READER SERVICE CARD



be a significant advantage—so long as you don't need more than the 22 minutes it lasted on the PC Labs battery rundown test.

GRiD supplies its "Internal/External" AC power pack which, in theory, can be installed directly in the battery-pack well. In practice, however, the power pack generates so much heat that GRiD cautions against using it internally if the machine is equipped with a gas plasma display or a 100MB hard disk. Not that we got to try this: in our evaluation unit, a rubber nub was installed on one of the contacts inside the battery-pack well to prevent internal power pack use. Connected via its external cable, the power pack quickly became nearly too hot to touch.

The GRiD 1530 is also plagued by an intolerable keyboard, which is somehow stiff and mushy at the same time and lacks any reassuring click. The Backspace key is too high and too far to the right. The Enter key is too small and too far to the left. The Insert and Delete keys find their home near the upper-right-hand corner, and the cursor-control keys nestle in where the rest of the Enter key should be.

Despite these detractions, the GRiD-Case 1530 is not without its advantages. While its black magnesium case feels solid and well-built, the 1530 is one of the lightest, sleekest 386 portables you'll find.

GRiD also offers an impressive range of expansion opportunities. For instance, a flip-up compartment above the keyboard lets you install one or two additional ROM chips for a maximum of 512K additional storage. GRiD sells DOS 3.3 in ROM for \$150. If you've got the ambition and know-how, you can also burn your own applications into ROM and install them for instant loading. The battery-pack easily doubles as an option compartment, and GRiD offers several handy cartridges—for a price. If the standard CGA external monitor port isn't adequate, you can buy the \$695 VGA/EGA adapter cartridge.

Internal factory options include an \$895, 80387 math coprocessor and a \$695, 2,400-bit-per-second Level 5 MNP modem. The external option port can accommodate a 5.25- or 3.5-inch floppy disk drive or a 40MB tape drive. The motherboard accepts up to 8MB of 120-ns. RAM on four SIP modules, and the machine's two 3.5-inch drive bays make room for two floppies, one floppy and one hard disk (20 or 40MB), or one 100MB hard disk.

The GRiDCase 1530 is a solidly built and stylish portable, but its slow processor speed and limited battery life dampen what

was once an industry-leading reputation. If you have a special demand that only the 1530's unusual breadth of expansion options will fill, by all means give it a try. Otherwise, put your money somewhere else.

GRID SYSTEMS CORP.

GRiDCase 1535 EXP

by Mitt Jones

What do you get when you add a two-slot expansion tray to the 386-based, 16-MHz GRiDCase 1530 (also reviewed here) and \$2,000 to its price? Why, the \$6,700 GRiDCase 1535 EXP, of course.

Constructed from the same tough black magnesium casing that has helped GRiD earn a faithful following, the 1535 EXP's 4-pound expansion tray measures a minuscule 1.9 inches high and connects to an expansion port along the bottom panel of the laptop. Locked into the tray by two sturdy clasps, you can move the laptop short distances with the tray, or leave the tray on the

desk as a docking station.

The tray draws its power through the 1535 EXP and makes room for one 16-bit slot and one 8-bit slot, each full-length and mounted horizontally.

The laptop itself is identical to the 1530 aside from the expansion connector and a rather strange limitation regarding its internal disk options. While the 1530 accommodates two 3.5-inch drives and lets you choose between a 20-, 40-, and 100MB hard disk drive for one of the them, the 1535 comes with room either for a 1.44MB floppy or a 40MB hard disk—period.

This compromise on portable data access appears to be the result of the same AC power supply limitations we discussed in our review of the 1530: because the expansion tray adds even more of a load to the laptop's small AC adapter, the unit cannot support both the expansion tray and two power-hungry disk drives.

To get around that problem, you'll have to order one of GRiD's optional external floppy disk drives, which takes its power from the nearest AC outlet. A 5.25-inch, 360K drive came with our evaluation unit. Oddly enough, the transformer that powers the external floppy disk drive is quite a bit bigger than the transformer that powers the laptop and its expansion tray.

As with the 1530, the keyboard of the 1535 ranks among the worst we've seen, primarily because of its convoluted layout. And, like the 1530, the 1535 EXP also runs at a top speed of only 12.5 MHz, despite its 16-MHz 80386.

Fortunately, our 1535 evaluation unit came with the 1535 EXP's standard-equipment backlit CGA LCD 1500-series display, rather than with the optional gas plasma display that accompanied our 1530 evaluation unit. The LCD display is bright, attractive, and handles CGA graphics well. It also draws much less power than the gas plasma screen. Our unit ran for nearly an hour on the PC Labs battery rundown test, still too short a charge for worry-free battery operation, but impressive compared to the 22-minute rundown time of our 1530 evaluation unit.

GRiD has done well by catering to the government and other large organizations with special needs, in part because of the solid construction of its machines but also because of the unusual wealth of options it offers. The GRiDCase 1535 EXP sticks to that philosophy and will appeal to quite a few buyers. But before you fall for this machine's trim profile, good looks, and ex-



GRiDCase 1535 EXP

GRiD Systems Corp., 47211 Lakeview Blvd., P.O. Box 5003, Fremont, CA 94537-5003; (800) 222-GRID; (415) 656-4700.

List Price: With 1MB RAM, CGA liquid crystal display, one serial, one parallel port, expansion tray, \$6,700; with 2MB RAM, 40MB hard disk, external 360K 5.25-inch floppy disk drive, utilities, DOS 3.3, \$8,340; with 2,400-bps internal Level 5 MNP modem, 80387/16 coprocessor, \$10,525.

In Short: Essentially a GRiDCase 1530 with a two-slot expansion tray, this attractive, rock-solid 386 laptop boasts an unusual range of options and a removable battery pack. Faults include a difficult keyboard, 12.5-MHz clock rate, and the inability to accommodate both an internal floppy and a hard disk.

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- MS DOS 3.3 or 4.01

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- 101 Key Keyboard
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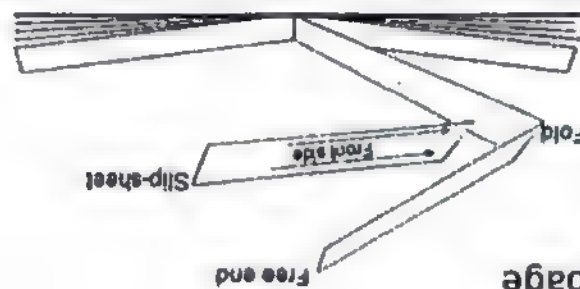
25 MHZ 486 VGA

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- 1.44 Meg 3.5" Drive
- 160 Meg ESDI Drive
- 32K Cache Controller
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

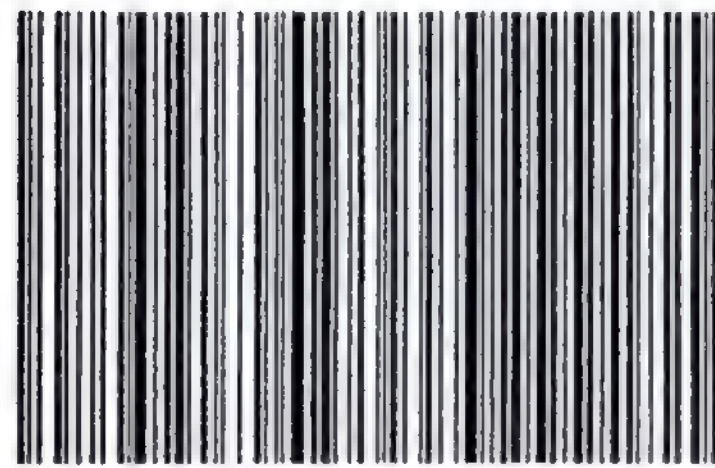
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Inverted Foldout Slip-sheet

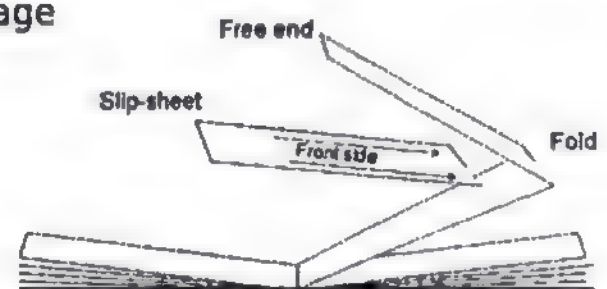


GbsSlipSheet-001

Folded edge of the page

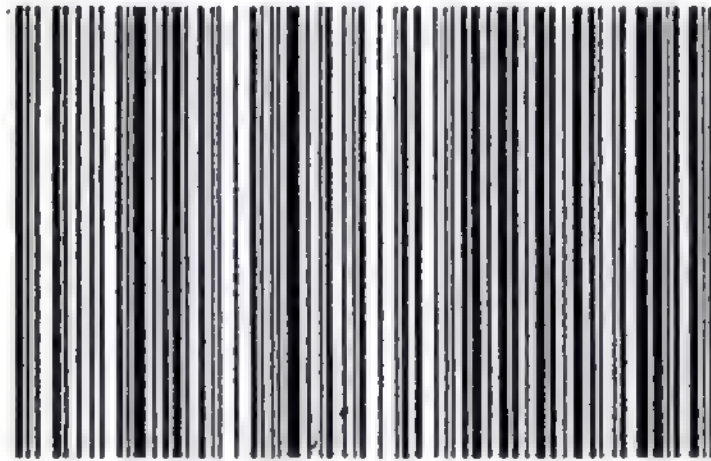
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Follow instructions on the other side

Inverted Back



GbsSlipBack-0018

Back

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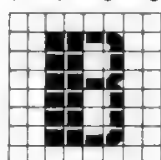
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Superintendent, Communications—Computer Operations

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pansion talents, you should take a close look at its liabilities.

IBM CORP.

IBM PS/2 Model P70 386

by Mitt Jones

IBM may not have a great track record with portables. But, even if it's only for the next 5 minutes, try to put those clunkers of days gone by out of your mind. The 20-MHz PS/2 Model P70 386 ranks, arguably, as the most usable 386 portable on the market.

The P70's base configuration sells for a hefty \$7,695, but that price hurts less when you consider what you're getting for the money: a 24-millisecond, 60MB hard disk with an integrated controller and 4MB of 85-nanosecond RAM.

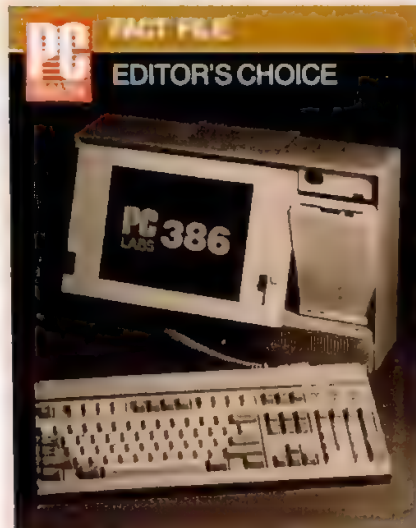
Our \$12,580 evaluation unit's motherboard came loaded with the maximum 8MB of 85-ns. memory (supplied via four 2MB SIMM packs), a 122MB hard disk, and a 20-MHz 80387 coprocessor. An optional, \$595 3270 emulation card arrived with the tested unit. Additional memory can be added via a full-length expansion card in the single 32-bit slot for a system maximum of 16MB. An optional 16-bit, 2,400-bps per-second MCA internal modem will cost you \$449.

Unlike many of the portables finding their way into overhead compartments these days, the P70 is designed solidly and intelligently. Though higher and longer than most lunchbox portables, the P70 is 5 inches thinner. The P70 won't leave you with chronic bruises on the outside of your leg the way thicker portables will, and at approximately 21 pounds in its standard configuration, the machine weighs less than many other competitors.

Swing the full-size 101-key keyboard down from its latched position and you'll find further evidence of thoughtful engineering. A hinged section at the top of the keyboard serves two functions: as a fastener to the lunchbox chassis in its natural position and as a keyboard angle support in its fold-down position.

A 1.44MB, 3.5-inch floppy disk drive is flush mounted vertically toward the right of the screen and pops out for use at an angle. Oddly, you must insert the disk upside down, with the label facing the system. Also, to get the drive to pivot back into its

PORTABLES 386- AND 386SX-BASED



IBM PS/2 Model P70 386

IBM Corp., (800) IBM-2468, contact your local authorized IBM dealer.

List Price: With 4MB RAM, 60MB hard disk, one 1.44MB 3.5-inch floppy disk drive, VGA gas plasma display, one parallel port, one serial port, one mouse port, utilities, \$7,695; with DOS 3.3, \$7,820; with 8MB RAM, 122MB hard disk, and a 20-MHz 80387 \$12,580.

In Short: This 20-MHz, MCA portable boasts a full-size 101-key keyboard and one of the best VGA gas plasma displays going. Overall, a wonderfully usable machine at a reasonable price.

CIRCLE 422 ON READER SERVICE CARD

flush-mounted position and stay there, you must push the drive at one demarcated spot or it pops back out. Of course, these aren't major problems, but they do take a bit of getting used to.

Along the back panel of the machine is a sliding doorway in a larger swing-open panel that allows access to the standard connectors: one each for a serial, parallel, and mouse port, and one for an external storage device. Open the larger panel and you'll see the external VGA monitor port, as well as the end openings to two MCA slots: one 16-bit and one 32-bit.

To fill the slots, you'll have to remove the back panel of the machine, but IBM makes this relatively easy. First you loosen three large screws with a coin. You then press the bottom panel of the machine at various latch points while pulling out on the back panel.

There is little space to spare inside this machine, but fortunately, all components you're likely to need access to—including the MCA slots, SIMM memory connectors, CMOS batteries, and math coprocessor socket—rest in plain view.

Another of the machine's superior qual-

ities is found in its display. Unlike most gas plasma screens, the IBM's screen background contains only a trace of orange, appearing nearly black behind the bright orange characters. And even though IBM advertises a 16-gray-scale 640- by 480 display, the machine manages to simulate additional shades using hatching. The results are outstanding. The P70 did a wonderful job with all of our graphics test images, including the 256-color Colorix files, exhibiting an almost eerie ability to decide how to map each shade. For instance, in one image containing a gradual fade from a yellow horizon through orange and purple to a starry blue sky, the IBM colored the sky with its near-perfect black, complete with stars. The IBM was also one of few machines to display a shaded sphere without generating plainly visible increments of shading.

On the down side, in a very few cases the P70 display lost portions of some images such as, ironically, the simulated shadows behind an IBM logo. Of course, no 16-shade display, no matter how thoughtfully designed, will handle 256-color images perfectly every time. More worrisome, the machine locked up consistently while attempting a certain portion of PC Labs VGA register-level compatibility tests and refused to run a suite of PC Labs CGA tests. We experienced no problems running other software on the machine—including OS/2. But be certain to test your favorite applications before putting down your money.

The IBM PS/2 Model P70 386 deserves a close look. It may not be the fastest, lightest, or most expandable machine around. But it is probably the most thoughtfully designed of the 386 luggables and is therefore a pleasure to use.

INTERNATIONAL INSTRUMENTATION INC.

Blue Max Attache 386

by Bill O'Brien

If you've been poking your nose around computers since the days of the S-100 bus, you'll probably remember a company called International Instrumentation Inc.—a.k.a. I3—which sold computer components through a few mail-order houses. The company has finally decided to take its components and assemble them into an IBM-compatible computer. Along with a desktop series, the results are the



Blue Max Attache 386

International Instrumentation Inc., 2282 Townsgate Rd., Westlake Village, CA 91361; (800) 543-DISK, (800) 346-DISK (in Calif.), (805) 495-7673.

List Price: With 640K RAM, 1.2MB 5.25 floppy disk drive, Paradise EGA board, Amber multiscanning HGA/CGA display, \$5,289; with 4MB RAM, 40MB hard disk, \$6,384; with 4MB RAM, 186MB hard disk with DPT disk caching controller, 1.44MB 3.5-inch and 1.2MB 5.25-inch floppy drive, one parallel port, one serial port, Orchid VGA board, HGA/CGA display, DOS 3.3, \$9,542.

In Short: An expensive, heavy machine, the Attache 386 provides more than four times the performance of the old Compaq Portable 286, giving users lots of power in a just barely luggable package.

CIRCLE 424 ON READER SERVICE CARD

33-MHz Blue Max Attache 386 and the 20-MHz 286 (also reviewed in this issue).

Of course, the term portable is stretching the definition somewhat for this \$9,542 (as tested) dynamo that weighs in at a hefty 32-pounds and comes in a briefcase-sized enclosure that bears a striking resemblance to the old Compaq Portable 80286. Perhaps it should be called a luggage cartable. But what this machine lacks in portability, it makes up for in performance. The Attache 386 is a strong contender in the heavyweight class; chock full of performance, it offers the power of a desktop machine in a form factor that can be transported from site to site.

The machine arrived at PC Labs for review containing a 186MB Imprimis drive (there's room for two, even with two floppy disk drives already in the system) connected to a DPT cache controller equipped with 512K of 100-nanosecond RAM. The cost of those two components alone might well pay for a low-end laptop, but the payoff is a set of disk benchmark test numbers that are unsurpassed in overall performance.

Likewise, the union of its rapid 33-MHz 80386 processor and the 4MB of installed 70-ns. system RAM was augment-

PORTABLES 386 AND 386SX-BASED

ed by 64K of processor RAM cache that catapulted the Attache 386 to the very top of the reviewed machines. This is nothing less than brute force—a Ferrari among subcompacts—and a Ferrari is neither small nor inexpensive.

Under the hood is a standard AMI motherboard using a Chips and Technologies chip set. While there are eight slots, two are lost under the video cage, which houses a real vidicon tube. The review machine had a monochrome tube that was HGA and CGA compatible—with VGA available to an external monitor. There is an optional VGA display card available that fits right inside the box; it hadn't been priced at the time of this review.

For a true definition of portable power, I3 has SCO Xenix running on its portables with ARCnet multiport cards. No other machine in the roundup can boast that you can carry it into an office and within a few minutes have it set up as the hub of an eight-user system. Nor can many desktop systems claim that the daily multiuser hub can become the weekend travel warrior.

Of course, not everyone wants a machine that can do that, especially with the weight penalty imposed by the hardware (32 pounds is nearly twice as heavy as some of the clamshells). I3 sells many of its computers to the aerospace industry, where a person can literally take his or her CAD system down the hall en masse without waiting for floppy diskettes to format or for printed output. When the Compaq Portable 286 arrived, many complained about its size but lugged it about anyway. The Attache 386 has at least four times the performance potential of the old Compaq, and if you don't mind compromising its portability in exchange for its dual role as a luggable and a real desktop machine, it may well surprise you.

MAXTRON

Maxtron LCD Portable 386

by Mitt Jones

Housed in the same worthy lunchbox case as the Dolch P.A.C. 386-25C and based on the same Chips and Technologies 386 chip set, the Maxtron LCD Portable 386 carries a base price of \$3,759 with 1MB RAM and a 44MB hard disk. That's about



Maxtron LCD Portable 386

Maxtron, 1825A Durfee Ave., South El Monte, CA 91733; (818) 350-5707.

List Price: With 1MB RAM, 44MB hard disk, 1.2MB 5.25-inch floppy disk drive, EGA backlit liquid crystal display, one parallel, one serial port, \$3,759; with 2MB RAM, 1.44MB 3.5-inch floppy disk drive, DOS 3.3, \$4,043.

In Short: This 25-MHz lunchbox machine suffered from numerous problems during evaluation, including the inability to run faster than 20 MHz. Despite an attractive case, a good keyboard, and three expansion slots, this portable suffers in comparison with its competition.

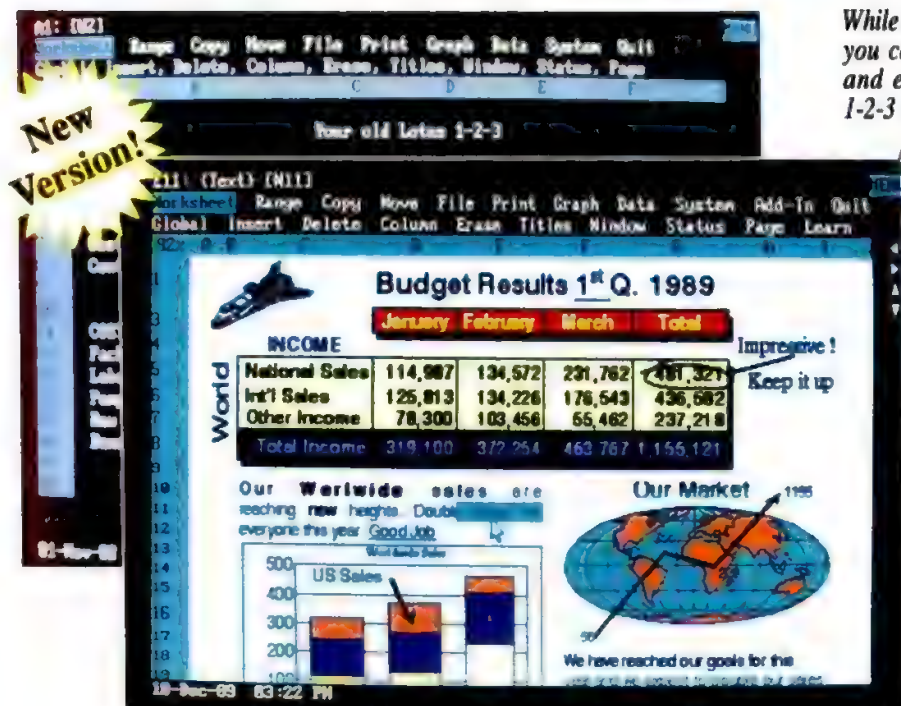
CIRCLE 407 ON READER SERVICE CARD

half of what you'd pay for the Dolch P.A.C. 386-25C. Unfortunately, our evaluation unit came with as many glitches as it did features.

Our evaluation unit's most serious failing became evident when we ran the PC Labs benchmark tests: though outfitted with a 25-MHz 80386 and represented as a 25-MHz machine, the system ran at a top speed of 16 MHz. The documentation, a collection of component manuals including an arcane volume for the Bison motherboard, failed to disclose how one changes the clock speed, though it did say that the motherboard was capable of running at 16, 20, or 25 MHz. Maxtron, when alerted to the problem, seemed as confused as we were.

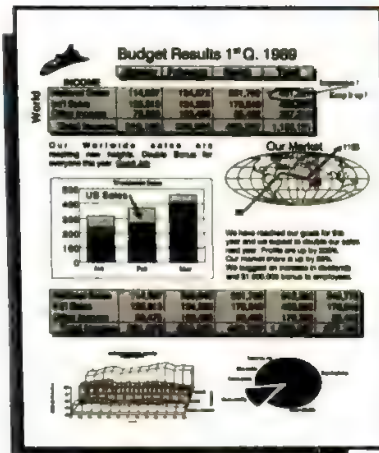
Ultimately, and without the benefit of much help from Maxtron, we discovered that the motherboard, though outfitted with the correct processor and identification stamp, came with a 20-MHz chip set as well as 12-, 32-, and 40-MHz crystals, which gave it a top speed of 20 MHz. After resetting one jumper to the setting opposite the one previously recommended by Maxtron, we ran the machine at 20 MHz.

With a little time and with access to Maxtron's inner workings, one could probably trace these problems to relatively simple errors made during the assembly



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IMPRESS brings a true graphic interface to Lotus 1-2-3. Full mouse support to call menus or open windows. Even a drawing tool box that allows you to draw any image in 1-2-3. Get a professional look quickly and easily without ever leaving 1-2-3.

Compress or Enlarge Worksheets

You can customize your 1-2-3 screen display with drawings, colors, grids and new exciting fonts. You can also zoom in and out to compress worksheets or enlarge them. See twice as many rows and columns of your worksheets on screen. No more scrolling around.

Mix Numbers, Text and Graphics

Create a professional report with numbers, graphs, images and text all on one page. Your graphs are customized. Your text automatically word wraps and is justified. You have a choice of different type styles and sizes with different fonts (3 pts. to 72 pts.). Many Bitstream Fonts included. Your images are created with the drawing tool box or imported from Freelance.

Also Prints Sideways

Print sideways with all printers from dot matrix to laser and desk jets. Print exciting colorful reports with color printers. IMPRESS can also compress worksheets automatically so they fit any page size you want.

Customize Graphs or Forms

Graphs can be real time synchronized with your worksheet. You can also include .PIC files or Freelance files. Customize your 1-2-3 graphs with arrows, explanations, fancy titles and drawings. Draw lines, boxes, grids or even freehand to create any form or invoice from inside 1-2-3. Then fill up your forms on screen and simply print them.

Easy to Use

If you know how to use 1-2-3, you already know how to use IMPRESS, it's fast and easy. There is no learning period. IMPRESS uses 1-2-3 like menus that you are already familiar with.

Allways and 1-2-3 Rel 2.0, 2.01, & 2.2

Compatibility

If you have Allways IMPRESS imports Allways files automatically. So you can improve them, print them sideways, or simply work on them without having to toggle to text mode. IMPRESS works with 1-2-3 Rel 2.0, 2.01, & 2.2.

Technical Requirements

IMPRESS works with: 1-2-3 release 2.0, 2.01 or 2.2, DOS 2.0 or later, CGA, EGA, VGA or Hercules (No color in CGA). Supports all graphics printers that work with 1-2-3: including Dot Matrix, Desk Jet, Laser printers (Hewlett Packard, Postscript, etc.). Color printers. IMPRESS occupies 93k RAM above 1-2-3 (uses EMS if available). Many Bitstream Fonts included with package. 1-2-3 is a registered trademark of Lotus Development Corp. Allways is a registered trademark of Funk Software.

	Allways	IMPRESS
1-2-3 stays fully functional & interactive	No	Yes
Enhance & customize 1-2-3 screen display	No	Yes
Print sideways on all printers	No	Yes
Synchronized live graphs	No	Yes
See and work with more rows & columns on screen	No	Yes
Drawing tool box	No	Yes
Import Freelance images or graphs	No	Yes
Word processing capabilities	No	Yes
Customize graphs with arrows, frames, drawings	No	Yes
Full mouse support	No	Yes

"Which is better? ... IMPRESS is the clear winner. It boasts nearly every additional feature I wished for when I reviewed Allways."

5/16/89 — PC Magazine

"IMPRESS ... a clear leader worthy of an excellent score. If you like Allways, you'll love IMPRESS."

9/4/89 — Infoworld

"Works magic ... the tremendous improvement over 1-2-3's screens and reports is obvious."

3/89 — Lotus Magazine

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process. What's difficult to believe is not that the mistakes were made but that the machine managed to find its way out the door so terribly botched.

Other problems were less significant: the machine came labelled incorrectly as a

PORTABLES 386- AND 386SX-BASED

286. The keyboard indicator lights came on at the wrong moments—undoubtedly the result of a reversed connection. And, upon attempting to run *Insight*, a PC Magazine utility that polls a system for configuration information, the screen went blank and remained that way, even after exiting the program. We were able to regain the DOS prompt by issuing a blind "MODE CO80" command.

As for assets, the Maxtron's top attraction has got to be the case itself, which is refreshingly good-looking, comes with an excellent keyboard, and leaves room for three open expansion slots after standard-equipment adapters have been installed. The crisp, eight-shade LCD screen is also a strength.

However, even if you're willing to overlook the shortcomings of our evaluation unit and its quality-control implications, the Maxtron LCD Portable 386 fails to stand out from the 386 portables crowd. With no static-RAM cache and a price above that of some of the more capable 25-MHz competition, it simply doesn't give you enough good reasons to buy it.

MICRO EXPRESS

Micro Express Regal SX

by Mitt Jones

The Regal SX not only sets another new low for Micro Express's line of ever-lower 80386SX-class portable prices, but also marks a first for the company itself. Though manufactured by Informtech, the motherboard was designed by Micro Express. Should you care? In this case, probably so: the Regal SX's versatile motherboard moves the machine slightly beyond the status of a plain-vanilla clone.

The 16-MHz lunchbox Regal SX, base priced at \$2,499 with a 1MB RAM and a 40MB hard disk, uses the same Compaq-like Chicony chassis and component peripherals as the Regal II (also reviewed here). The machine also boasts the same 15-month warranty, four months of on-site service, and 30-day money back guarantee as its 80386-based sibling.

At the heart of the Regal SX, the motherboard gives you a few additional things

The Maxtron's top attraction is its case, which is good-looking, comes with an excellent keyboard, and leaves room for three open expansion slots. The crisp LCD is also a strength.

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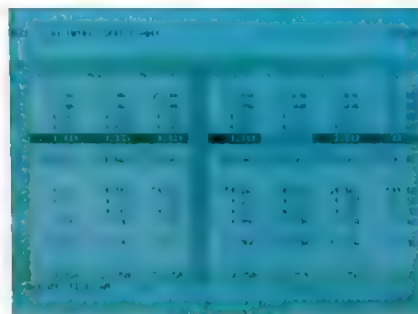
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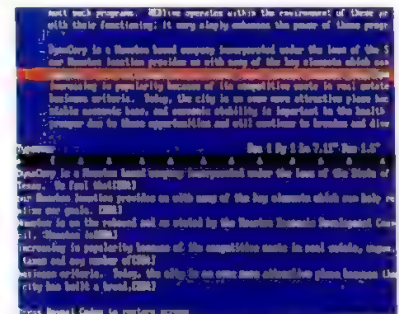
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PORTABLES 386- AND 386SX-BASED

to smile about. First, while Micro Express now advertises the machine at 16 MHz, most of the chips on the motherboard are rated for 20 MHz, including the Chips and Technologies NEAT chip set. Motherboard jumpers allow you to choose from three processor speeds: 8, 16, and 20 MHz; and three bus speeds: 8, 10, and 12 MHz. Of course, the 80386SX processor and 80387SX math coprocessor supplied with our evaluation unit were rated at only

16 MHz, making 20 MHz a risky setting. But one gets the feeling that Micro Express is poised to market the machine at 20 MHz as soon as it can get its hands on the faster SX chips. In fact, our evaluation unit came set to run at 20 MHz and with "20" penciled in on the 386SX chip, though we reset the machine to run at 16 MHz before running the PC Labs benchmark tests.

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CIRCLE 735 ON READER SERVICE CARD



Micro Express Regal SX

Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; (800) 642-7621, (714) 852-1400.

List Price: With 1MB RAM, 40MB hard disk, 1.44MB 3.5-inch floppy disk drive, external 5.25-inch 1.2MB floppy disk drive, EGA gas plasma display, one parallel, two serial ports, utilities, \$2,499; with 2MB RAM, DOS 3.3, \$2,774; with 157MB hard disk, 80387SX coprocessor, \$4,274.

In Short: This 16-MHz, 386SX lunchbox portable combines competent components, a feature-packed motherboard, and an excellent warranty/service package, all at an accountant-pleasing price.

CIRCLE 408 ON READER SERVICE CARD

Other motherboard features include jumper-selectable memory RAM wait states, system and video BIOS shadowing, and a ROM-based expanded memory manager and disk caching utility, both provided courtesy of the NEAT chip set and activated via an extended setup utility. The motherboard holds a maximum of 2MB of parity-checked, page-interleaved RAM, but a proprietary slot will accommodate additional 16-bit memory up to 10MB, running at processor speed.

The Regal SX is not without its flaws. Like the Regal II, its EGA gas plasma screen generates only four shades. The keyboard puts a few important keys into odd places, making its use awkward. And Micro Express has yet to graduate from the low-end, mail-order habit of shipping machines with component-part manuals instead of true user documentation, a deficiency the company is trying to fix.

All in all, the Micro Express Regal SX represents an excellent bargain. The generous warranty and on-site service pledge seem to indicate a company prepared to back its products. Along with a solid design and noteworthy features, the Regal SX is a bargain-priced portable truly worthy of a thumbs-up recommendation.

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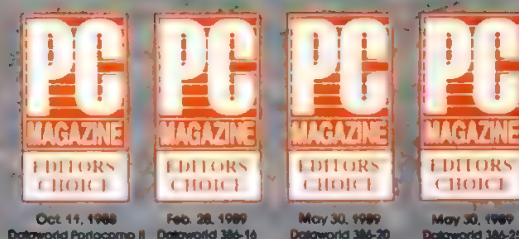
CIRCLE 369 ON READER SERVICE CARD

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PC MAGAZINE **INDURANCE TEST**
DATA 386-SX
January 16, 1990

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- 40MB, 25mS hard drive (IDE interface)
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DATA 386SX \$1295



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Compaq Deskpro 386S	4.48	9.67	0.83

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MICRO EXPRESS

Micro Express
Regal II

by Mitt Jones

After you've looked at enough low-cost machines, you find yourself asking the same simple question: Why would I buy this machine over another? The Micro Express Regal II, a 386-based, 25-MHz, gas-plasma-display lunchbox portable, is one of the few low-cost alternatives that gives some good answers.

The Regal II presents high quality at budget prices. Complete with 2MB of RAM, a 40MB hard disk, and DOS 3.3, the machine sells for a miser-pleasing \$3,274. Constructed on the Compaq-like Chicony chassis and the AMI motherboard, its components are stamped with familiar names. Moreover, its performance is strong, thanks in part to AMI's 25-nano-second, 64K static RAM cache.

Our \$5,344 evaluation unit came loaded with 4MB of RAM, a 160MB ESDI hard disk, a 1.44MB floppy disk drive, and a 25-MHz 80387 math coprocessor, plus an external 5.25-inch 1.2MB floppy drive that connects to a standard external floppy disk drive port. Other standard features include one parallel port, two serial ports, a game port, and a reset switch, all supplied via the slot openings on the left panel of the chassis.

As important as performance and construction is vendor support. Micro Express, which sells its machines strictly via mail order, gives you that and a bit more. The Regal II comes with a 15-month parts-and-labor warranty, and you get the luxury of free on-site service for the first four months. Add a 30-day money-back guarantee, toll-free support, and two-way shipping should the machine need to be returned to the factory, and you've got a deal that's difficult to beat.

As with most lunchbox machines, the Regal II does have its drawbacks. The EGA gas plasma screen, for instance, while excellent for applications requiring only text modes and simple graphics, will be too limited for those who need sophisticated graphics. Driven by a Gemini EGA adapter, the four-shade screen does a nice job with CGA and eight-color EGA images. The machine made a valiant attempt with our 16-color test image—a stock digitized portrait—but the color transitions

were too abrupt, leaving the blond bombshell with hair straight out of a punk-rock nightmare and with just a few too many rings under her eyes, and nose, and mouth . . . You get the picture. The Gemini adapter supplies a connector for an external EGA monitor for times when four shades just won't do. Unfortunately, the gas plasma screen won't operate simultaneously with the external display.

The 102-key keyboard may be another area of contention for some users. The layout shares the tendency of most other portables to tuck a few important keys into hard-to-reach places. The most irksome feature of this particular layout seems to have come as the result of Chicony's embedding the four cursor arrow keys into the bottom right of the primary alphanumeric keypad. The Shift key moves to the left to make room for the Up Arrow key, and the key holding the slash and question mark slides all the way to the other side of the Up Arrow key. Twelve function keys line up in two rows left of center along the top of the machine's keyboard. All this makes for

an awkward configuration at best.

And even though the AMI motherboard supplies plenty of slots—six 16-bit, one 8-bit, and a proprietary 32-bit, which holds all 80-ns. system memory—the 180-watt power supply covers three of the 16-bit slots. Add an 8-bit I/O board, an 8-bit EGA board, and the 16-bit ESDI hard disk controller, and you're left with just one open 16-bit slot.

The Micro Express Regal II isn't perfect: if you need sophisticated graphics, more than one free expansion slot, and a true standard keyboard, look elsewhere. But if you're looking for a fast 386 lunchbox portable at a great price, this machine may be for you. With four months of on-site service, 30 days to change your mind, and 15 months of full parts-and-labor warranty, the Regal II presents a rare combination in the portable PC marketplace: a safe choice and a bargain.

MICRO TELESIS INC.

Micro Telesis 386
Portable

by Bruce Brown



Micro Express Regal II

Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; (800) 642-7621, (714) 852-1400.

List Price: With 1MB RAM, 64K processor RAM cache, 40MB hard disk, one 1.44MB 3.5-inch floppy disk drive, EGA gas plasma display, one parallel, two serial ports, utilities, \$2,999; with 2MB RAM, DOS 3.3, \$3,274; with 4MB RAM, 157MB hard disk, external 1.2MB 5.25-inch floppy disk drive, 80387/25 coprocessor, \$5,344.

In Short: This 25-MHz lunchbox portable offers high-end performance and excellent vendor support at a remarkably low price. The machine comes with four months of free on-site service, a full 15-month parts-and-labor warranty, and a 30-day money-back guarantee. Weak points include an EGA-only, four-shade display.

CIRCLE 409 ON READER SERVICE CARD

The \$2,795 Micro Telesis 386 Portable is an AC-only lunchbox computer notable largely for its low price. Indeed you get a lot for your dollar here.

The 386 Portable has a Unitron 386 20-MHz motherboard with an AMI ROM BIOS, but no RAM cache. The low price for this unit includes 2MB RAM, a 40MB hard disk, a 1.2MB 5.25-inch floppy disk drive, an EGA gas plasma display, one serial and one parallel port, and MS-DOS.

The case measures approximately 9.66 by 16.25 by 8.75 inches (HWD) and weighs 23.2 pounds—about the lunchbox-style average. A reasonably comfortable padded handle on top and a nylon carrying case are both standard.

You can put up to 8MB of 100-nano-second 1-megabit SIP-style memory directly on the motherboard. A 32-bit expansion slot accepts a memory expansion board that can hold another 8MB, for a system total of 16MB. The motherboard also has sockets for an 80287 coprocessor running at either 10 or 20 MHz, or a 20-MHz Weitek 1167 math coprocessor chip, only one of which can be installed at a time.

Besides the 32-bit expansion slot, there are two 8-bit and four 16-bit slots, with one of each type covered by the power supply.



Micro Telesis 386 Portable

Micro Telesis Inc., 1260 Logan A2, Costa Mesa, CA 92626; (714) 557-2003.

List Price: With 1MB RAM, 20MB hard disk, 1.2MB 5.25-inch floppy disk drive, EGA gas plasma display, one serial and one parallel port, utilities, \$2,349; with 1MB RAM, 84MB hard disk, \$2,749; with 2MB RAM, 40MB hard disk, DOS 3.3 or 4.01, \$2,795.

In Short: This noncaching 20-MHz 386 lunchbox portable combines standard components with a good price, making it attractive to cost-conscious buyers.

CIRCLE 410 ON READER SERVICE CARD

Available in our tested configuration were one 8-bit slot, one 16-bit slot, and the 32-bit slot, which can be used with either 8- or 16-bit boards as well.

The test machine came with an 84MB Seagate SCSI hard disk and the standard 1.2MB floppy disk drive. There's an extra 3.5-inch drive bay if you want to add another standard storage device.

The Micro Telesis display is standard EGA gas plasma and could only display four shades of gray in our graphics tests. Because of its four-shade capability, you'd probably be better off using it for text-based applications. There is a 9-pin port for an external EGA or CGA monitor.

The 86-key keyboard includes 12 function keys across the top. You can plug a standard AT-style keyboard into the case.

Micro Telesis sells computers only via mail order and offers a 13-month parts-and-labor warranty. If a component proves defective in the first 30 days of ownership, they'll send the replacement part via UPS overnight before you send in the defective part. For the last 12 months you have to send the bad part back first, or send in the whole computer for a promised 48-hour repair turnaround.

While there's nothing outstanding here,

the price is low. If you're really shopping and only a 386 20-MHz AC-only luggable computer will do, Micro Telesis may have just the deal for you.

NATIONAL MICRO SYSTEMS INC.

National Micro Systems Gas Plasma 386SX-16

by Bruce Brown

At \$1,999, National Micro Systems' basic-configuration gas plasma 16-MHz 386SX—which includes 1MB RAM, 40MB hard disk, 1.2MB floppy disk drive, 640 by 400 gas plasma CGA-compatible display, one parallel and one serial port, carrying case, and DOS 3.3—is one of the least expensive lunchbox systems on the market. And while it might not have the punch of some 20- and 25-MHz 80386-based machines, the Gas Plasma 386SX-16 offers an excellent compromise between desktop power, portability, and price competitiveness. A standard system with 2MB RAM, 43MB hard disk, and the VGA option costs \$2,749.

National Micro Systems has based its system on an Informtech motherboard with Chips and Technologies' 386SX chip set and a Phoenix ROM BIOS. You can fit only 2MB of zero-wait-state RAM directly on the motherboard, using 80-nanosecond DIP-mounted chips. But a standard FastRAM slot lets you add a \$149 memory card that can hold up to 8MB of RAM for a system total of 10MB. National Micro sells the extra memory chips for \$150 per megabyte.

The Informtech/Chips and Technologies/Phoenix combo performs admirably, with better scores than most other SXs on the PC Labs processor and memory benchmark tests.

The rest of the Gas Plasma 386SX story is the familiar recitation of standard lunchbox features. The AC-power-only, FCC Class A-rated 386SX weighs a bit more than 22 pounds and measures 9.75 by 16 by 8.75 inches (HWD). It has a padded handle on top and a detachable 86-key keyboard that plugs into the left side of the case by means of an 18-inch coiled cable. There's a reset button on the front, and the screen has a brightness control but no contrast adjustment.



National Micro Systems Gas Plasma 386SX-16

National Micro Systems Inc., 2833 Peterson Pl., Norcross, GA 30071; (800) MICRO 49, (404) 446-0520.

List Price: With 1MB RAM, 20MB hard disk, 1.2MB 5.25-inch floppy disk drive, CGA gas plasma display, one serial and one parallel port, DOS 3.3, carrying case, \$1,899; with 43MB hard disk, \$1,999; with 2MB RAM, VGA display, \$2,749.

In Short: National Micro Systems' Gas Plasma 386SX-16 combines good price and good performance but cries out for video upgrades; even with those costs factored in, it's still a bargain.

CIRCLE 411 ON READER SERVICE CARD

Our CGA test version displays four shades of gray—not a heavy-hitter graphics system. If you want a better screen, the upgrades to EGA (\$150) or VGA (\$600) are likely to be more effective.

The Gas Plasma 386SX uses a Seagate 43MB hard disk and a Fujitsu 1.2MB floppy disk drive, both administered by a DTC combination drive controller. There is room for an additional 3.5-inch floppy, hard, or internal tape drive.

The Informtech motherboard comes with two 8-bit slots, five 16-bit slots, and the proprietary FastRAM slot, which can also hold a standard 8-bit card. Three of the slots are covered by the power supply. The standard complement of interface cards left one slot free in addition to the FastRAM slot.

National Micro Systems sells only by mail order from its Norcross, Georgia, facility. A one-year warranty comes standard with all service performed at Norcross.

The National Micro Systems 386SX machine holds its own, though you'll probably want better video than what we found on our test machine. If both lunchbox expandability and 386SX price appeal to you, here's one to consider.

NATIONAL MICRO SYSTEMS INC.

National Micro Systems Gas Plasma 386-25

by Bruce Brown

We reviewed National Micro Systems' Gas Plasma 386-25 lunchbox in our December 12, 1989, roundup of 80386-based portables. Since then a few changes have taken place, although we were unable to obtain an updated machine for our review. Most significantly, the new case accommodates an additional 3.5-inch floppy disk drive, and there are also EGA and VGA video options, notable improvements over the CGA mode of our review machine.

Our \$4,398 test machine included 4MB RAM, an 80MB hard disk, a 1.2MB 5.25-inch floppy disk drive, a CGA-compatible gas plasma display, one serial and one parallel port, an 80387 25-MHz math coprocessor, a carrying case, and MS-DOS 3.3. And while all this power is hampered only by the 386-25's mediocre display, the

PORTABLES 805- AND 8086-BASED

\$150 EGA or \$600 VGA upgrade should help significantly. A standard configuration with 2MB RAM, 40MB hard drive, and VGA display costs \$3,698.

The AC-only FCC Class B-rated 386-25 weighs almost 23 pounds and measures 9.75 by 16 by 8.75 inches (HWD). National Micro Systems provides a 180-watt power supply, an 86-key keyboard, a Compaq Portable III clone case, and Orchid I/O and CGA video cards. Both the

A fully loaded Gas
Plasma 386-25 would
be inexpensive and
impressive but heavy.

optional 80MB CDC hard disk and the standard 1.2MB Fujitsu floppy disk drive in our test machine were managed by a Western Digital controller card. Other hard disk options include a 40MB Seagate and a 100MB Conner Peripherals drive.

The AMI motherboard has eight expansion slots, including a proprietary memory slot, one 8-bit slot claimed by the video card, and six 16-bit slots, two of which are occupied. Three of the remaining four slots are covered by the power supply, leaving just one slot free.

The AMI motherboard, along with its AMI ROM BIOS and Chips and Technologies 386 chip set, sports a standard 64KB RAM cache. All memory resides on a standard, 8MB-maximum RAM card. A \$149 daughterboard can hold another 8MB, for a 16MB maximum. The memory cards take 80-nanosecond 1-megabit chips. Using the RAM cache and page-mode memory interleaving, the 386-25 scored better than average for 25-MHz 386 machines on the PC Labs processor and memory benchmark tests.

The 386-25 comes with a one-year parts-and-labor warranty, serviced by National Micro Systems, which sells only via mail order.

This machine, with the VGA video upgrade, a full 16MB of RAM, a second hard disk, and a math coprocessor chip, would be a relatively inexpensive and impressive configuration—although it would proba-

bly weigh more than 25 pounds. If you don't mind hefting all that power, this portable might be for you.

NEC TECHNOLOGIES INC.

NEC PowerMate Portable SX

by M. David Stone

Weighing in at 21.5 pounds and measuring 11.25 by 16 by 8 inches (HWD), the 16-MHz NEC PowerMate Portable SX is one of the few lunchbox portables that looks more impressive on the inside than the outside. Taller and proportionately thinner than most lunchbox designs, it somehow seems less solid. But open it up and you can't fail to be impressed by the quality construction and intelligent design.

This high quality goes a long way toward explaining the base price of \$5,999, which is more than the tested price of some 25-MHz 386 portables. The rest of the explanation is that the system is fully equipped and ready to run. In fact, the PowerMate Portable SX is one of the few lunchbox systems for which the as-tested



National Micro Systems Gas Plasma 386-25

National Micro Systems Inc., 2833 Peterson Pl., Norcross, GA 30071; (800) MICRO 49, (404) 446-0520

List Price: With 1MB RAM, 40MB hard disk, 1.2MB 5.25-inch floppy disk drive, CGA gas plasma display, one serial and one parallel port, DOS 3.3, carrying case, \$2,899; with 2MB RAM, VGA gas plasma display, \$3,698; with 4MB RAM, 80MB hard disk, 80387 25-MHz math coprocessor, CGA gas plasma display, \$4,398
In Short: A respectably performing and competitively priced 386-based 25-MHz lunchbox clone, limited by its standard CGA video adapter. If you go for this one, spring for a video upgrade.

CIRCLE 412 ON READER SERVICE CARD



NEC PowerMate Portable SX

NEC Technologies Inc., 1255 Michael Dr., Wood Dale, IL 60191-1094, (800) 826-2255, (708) 860-9500

List Price: With 2MB RAM, 42MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA gas plasma display, one parallel and one serial port, utilities, DOS 3.3, GW-BASIC, \$5,999
In Short: The NEC PowerMate Portable SX offers high-quality construction, better-than-average text readability on its gas plasma display, a keyboard layout with no compromises, and three empty full-length slots. Alas, 42MB is your only choice in hard disks.

CIRCLE 413 ON READER SERVICE CARD

price is the same as the base price.

The base price includes a 28-millisecond 42MB hard disk, a 1.44MB 3.5-inch floppy disk drive, 2MB of RAM, a VGA gas plasma display, and DOS 3.3 and GW-BASIC. (According to NEC, the system specifications call for 80-nanosecond SIPs, but the tested unit had a mix of 80-ns. and 100-ns. chips.)

The PowerMate Portable SX opens from the top, a somewhat unusual arrangement. Remove the top panel—which is held by a single screw—and you look down into a remarkably uncluttered computer. The NEC motherboard is mounted on the back of the unit and includes a Phoenix BIOS, the Paradise PVGA1A chip set, one parallel connector, one serial connector, and a chip set consisting of a mixture of Intel and proprietary NEC chips. The disk controller is also included, by way of a daughterboard.

Roughly halfway down from the top of the system, and forming a T with the motherboard, is a board with three 16-bit slots. All three were empty on the test system, and all three can take full-length boards, leaving lots of room for expansion. According to NEC, the 130-watt power supply offers more than enough wattage for three power-hungry boards, thanks to a highly efficient VLSI design for the NEC chips in the system's chip set.

The motherboard sports a dedicated connector for additional high-speed memory, with a 2MB daughterboard available for \$1,495 or a 4MB daughterboard for \$2,995. The 4MB board can be expanded to 8MB for \$2,795, giving a maximum of 10MB of high-speed memory for the system. (You can add up to 6MB more with any standard 16-bit memory card.) The only additional option is an 80387SX. Notably absent is a higher-capacity hard disk option.

The keyboard offers good kinesthetic feedback and few compromises on layout. If you're used to the Enhanced-style keyboard, you'll be immediately comfortable with this one. The gas plasma display offers good contrast and brightness and lets you adjust the angle easily to avoid glare.

The screen, which offers 16 shades of gray, is mapped to work best with color screens. On a PC Labs test that creates a 16-shade picture of a human face, the resulting image looked like a horror mask. To solve this problem, NEC supplies a utility to remap the shades. In our tests, the automatic remapping function didn't help much, but we were able to get a good im-

age through manual remapping. Unfortunately, once you've found the mapping you need for a given program, the only way to store the information is by writing it in a batch file.

Two final features worth mention are the one-year warranty and the FCC Class B rating, which makes the PowerMate Portable SX one of the few lunchbox systems certified for home use.

All told, the NEC PowerMate Portable SX is a well-built system with some limitations in disk-drive capacity and graphics display. If you don't mind these shortcomings and you're willing to pay extra for the quality construction, this machine belongs on your list of possibilities.

NEC TECHNOLOGIES INC.

NEC ProSpeed CSX Color Laptop Computer

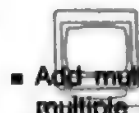
by Tony Rizzo

The color laptop is here; the technology works. That said, let's leave the issue of the NEC ProSpeed CSX's color display—which really is this portable's reason for existence—for last and look at the rest of the machine.

The \$8,499 CSX is a competent performer—our benchmark tests show the machine to be competitive in all respects. Its 16-MHz 386SX processor is no match for the 25-MHz machines, of course, but it is suitable for many of the tasks one might ask a portable machine to perform. The standard configuration includes a 42MB hard disk (a 100MB disk is optional), a 1.44MB 3.5-inch floppy disk drive, and 2MB of RAM. Expansion options include support for an 80387SX coprocessor, a 2,400-bit-per-second internal modem card, and an additional 2MB of RAM. The CSX offers an external VGA connector, a serial port, a parallel port, and an FDD connector for adding an external floppy disk drive.

Adding either expansion card is quite simple. A cover located directly underneath the keyboard is removed and the cards simply snap into their proprietary slots. Nothing could be easier. My only complaint here concerns the cheap piece of plastic used as a cover. It will brook no abuse.

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BENCHMARK TESTS: 386- AND 386SX-BASED PORTABLES

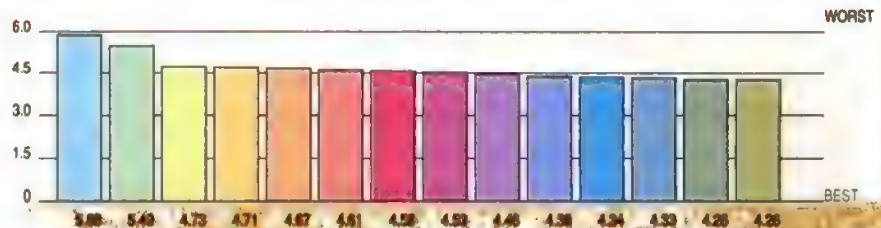
As the only 33-MHz 386, International Instrumentation's Blue Max Attache 386 easily tops the field; at 32 pounds, however, its portability is in question. The 16-MHz NEC ProSpeed 386 Laptop Computer is the fastest battery-powered laptop,

with the Dell 316LT also performing well. The new Zenith SupersPort SX and the Toshiba T3100SX are moderate battery-driven performers, but the faster 386s, running at speeds of 20 MHz and above, are still AC-only.

PROCESSOR AND MEMORY BENCHMARK TESTS

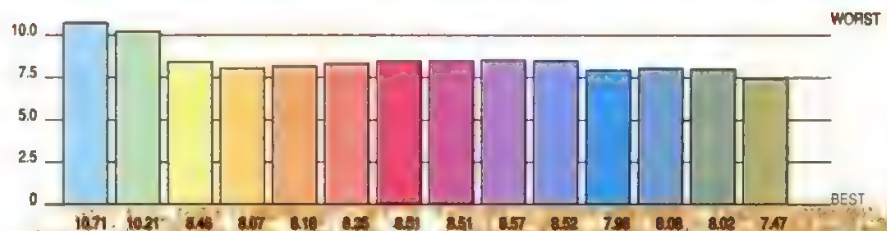
80386 Instruction Mix

The 80386 Instruction Mix benchmark test times a series of tasks specific to the 80386 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.



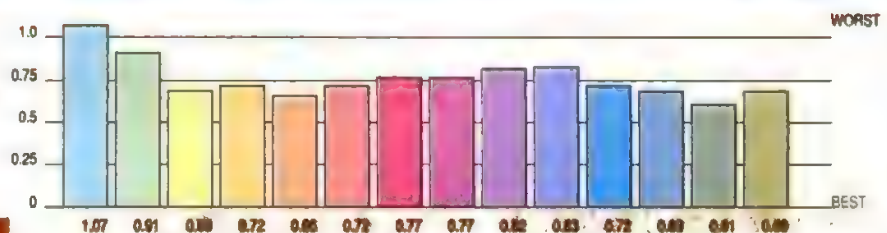
Floating-Point Calculation Without Coprocessor

The Floating-Point Calculation Without Coprocessor benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.



Conventional Memory

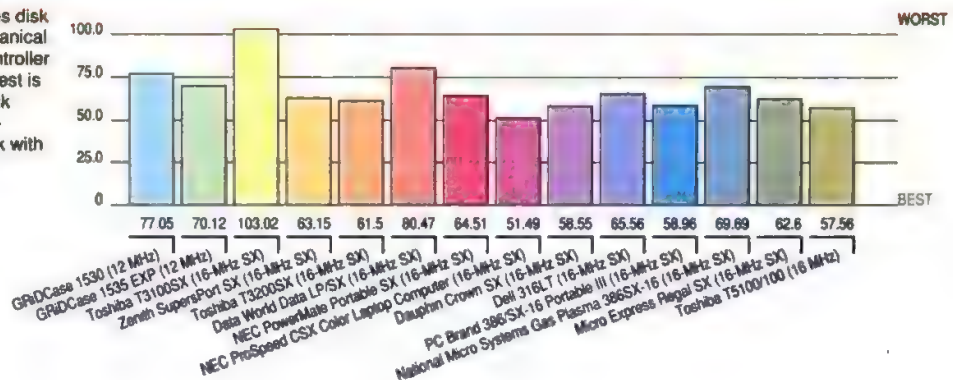
The Conventional Memory benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.



DISK BENCHMARK TESTS

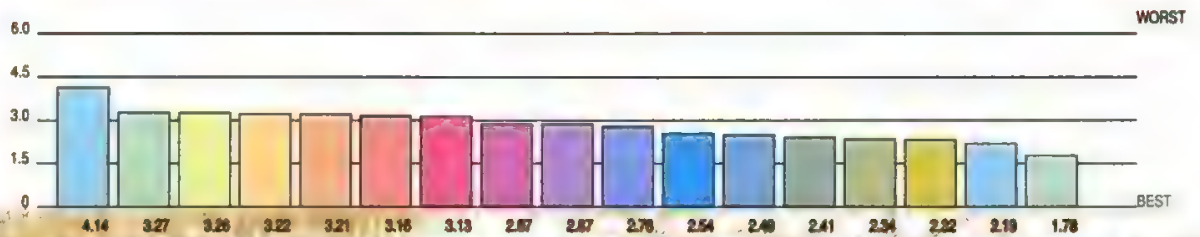
DOS File Access (Small Records)

The DOS File Access (Small Records) benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.

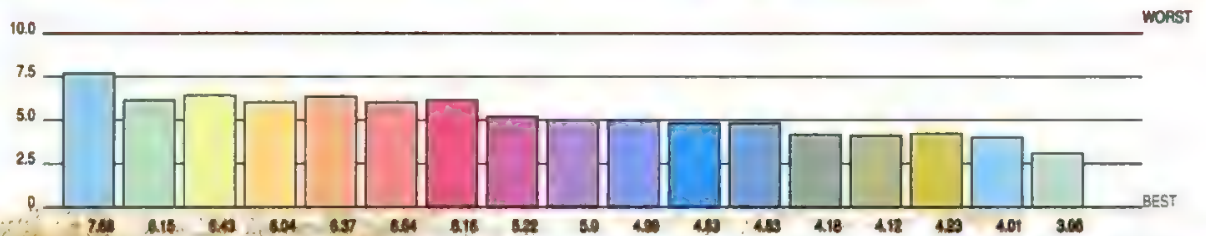


386- AND 386SX-BASED

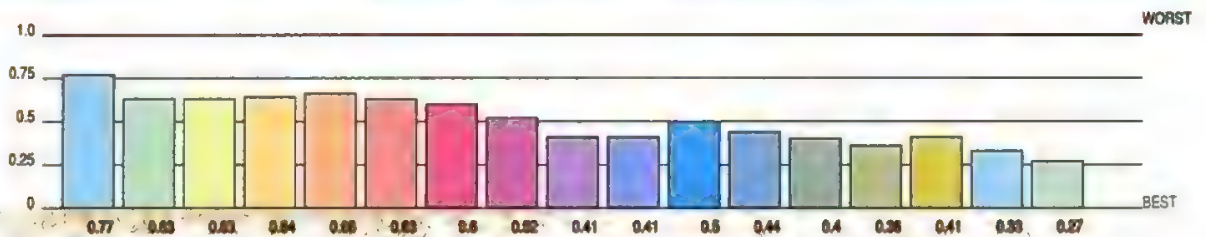
Elapsed Time (seconds)



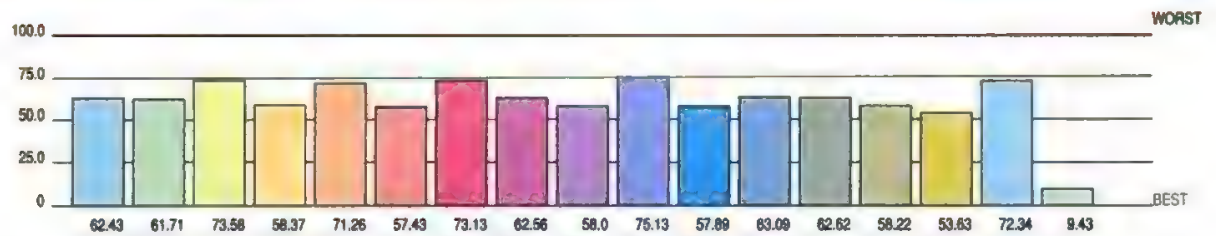
Elapsed Time (seconds)



Elapsed Time (seconds)



Elapsed Time (seconds)



NEC ProSpeed 386 Laptop Computer (16 MHz)
 Data World Portacomp 386-20 (20 MHz)
 Maxtron LCD Portable 386 (20 MHz)
 PC Brand 386/20 Portable III (20 MHz)
 Dolch P.A.C. 386-20 (20 MHz)
 Compaq Portable 386 (20 MHz)
 IBM PS/2 Model P70 386 (20 MHz)
 Pan United Micro Labs 386/20L (20 MHz)
 Toshiba T5200/100 (20 MHz)
 Micro Telesis 386 Portable III (25 MHz)
 PC Brand 386/25 Portable (25 MHz)
 Tangent 386/25 Portable (25 MHz)
 Micro Express Regal II (25 MHz)
 Dolch P.A.C. 386-25C (25 MHz)
 National Micro Systems Gas Plasma 386-25 (25 MHz)
 * IBM PS/2 Model 70-A21 (25 MHz)
 Blue Max Attache 386 (33 MHz)

* Reported for comparison.

CONTINUES

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- 1.44 MB Floppy Drive
- 101-Key Enhanced Keyboard
- MS DOS (choose 3.3 or 4.01)
- On-board VGA Controller
- Memory Management disk cache program software
- Five slots

Base system:	\$2,255
40 MB VGA mono system	\$3,087
40 MB VGA color system	\$3,417
76 MB VGA mono system	\$3,561
76 MB VGA color system	\$3,891

Model AT316S-6 80386SX 16Mhz

- Industry Standard Architecture
- 1 MB RAM expandable to 8 MB on CPU Board
- 1.2 MB or 1.44 MB Floppy Drive
- 101-Key Enhanced Keyboard
- MS DOS (choose 3.3 or 4.01)
- Integrated Floppy Controller
- Memory Management Software

Base system:	\$1,458
40 MB VGA mono system	\$2,169
40 MB VGA color system	\$2,499
100 MB VGA mono system	\$2,586
100 MB VGA color system	\$2,916

Model AT216-6 80286 16Mhz

- Industry Standard Architecture
- 1 MB RAM expandable to 8 MB on CPU Board
- 1.2 MB or 1.44 MB Floppy Drive
- 101-Key Enhanced Keyboard
- MS DOS (choose 3.3 or 4.01)
- Integrated Floppy Controller
- Memory Management Software

Base system:	\$1,263
20 MB VGA mono system	\$1,863
20 MB VGA color system	\$2,193
40 MB VGA mono system	\$1,974
40 MB VGA color system	\$2,304

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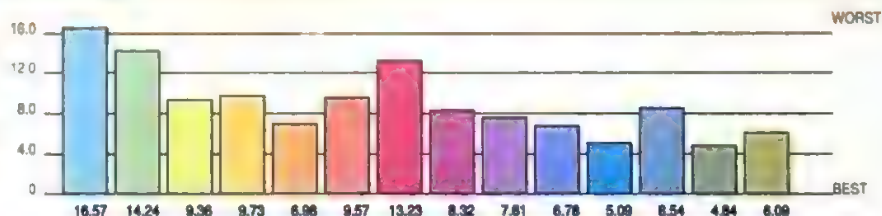
CIRCLE 350 ON READER SERVICE CARD

BENCHMARK TESTS: 386- AND 386SX-BASED PORTABLES

DISK BENCHMARK TESTS

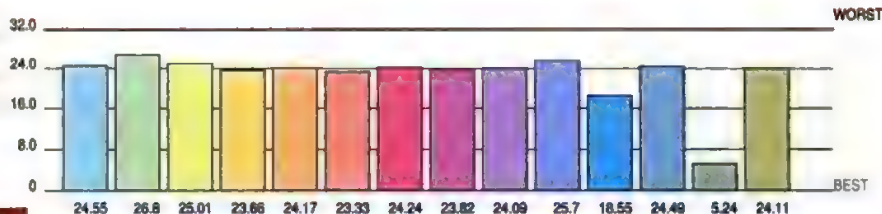
DOS File Access (Large Records)

The DOS File Access (Large Records) benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.



BIOS Disk Seek

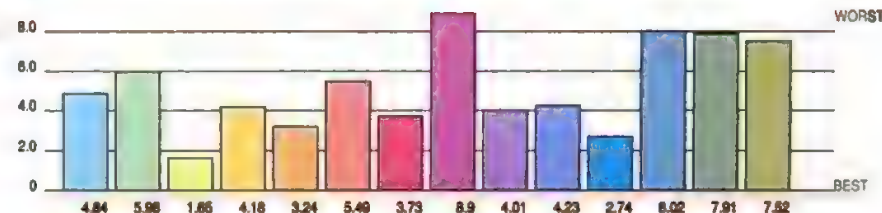
The BIOS Disk Seek benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.



VIDEO BENCHMARK TESTS

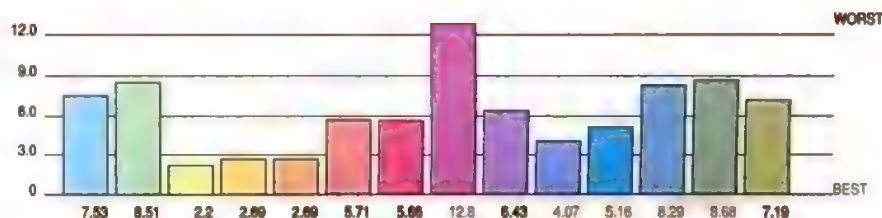
Direct to Screen

The Direct to Screen benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.



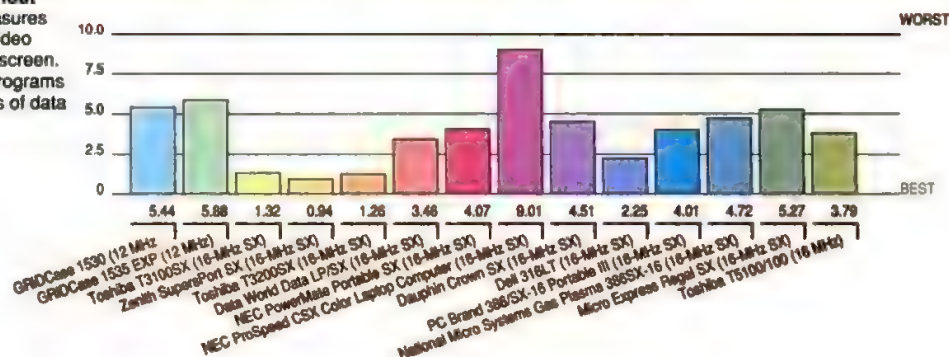
Video BIOS Routine with Scrolling

The Video BIOS Routine with Scrolling benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.



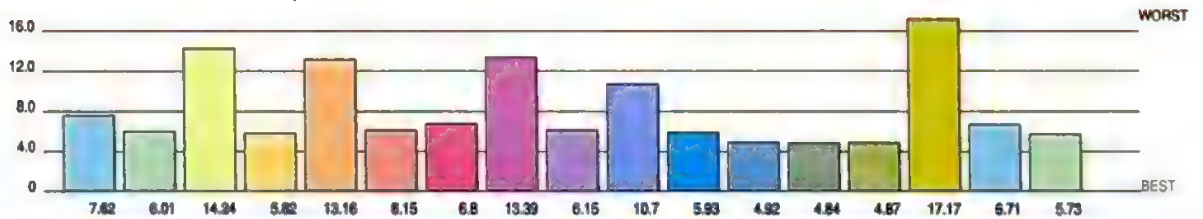
Video BIOS Routine Without Scrolling

The Video BIOS Routine Without Scrolling benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.

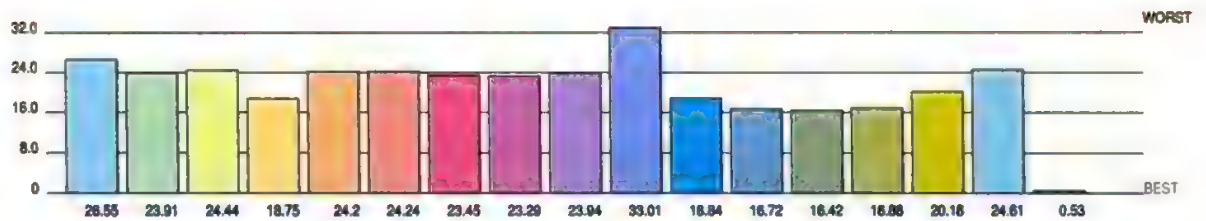


PORTABLES 386- AND 386SX-BASED

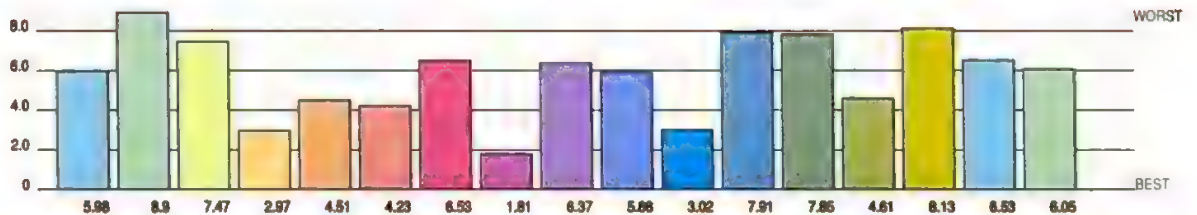
Elapsed Time (seconds)



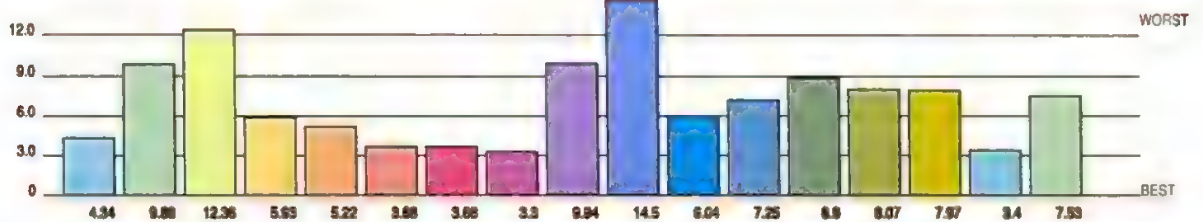
Elapsed Time (milliseconds)



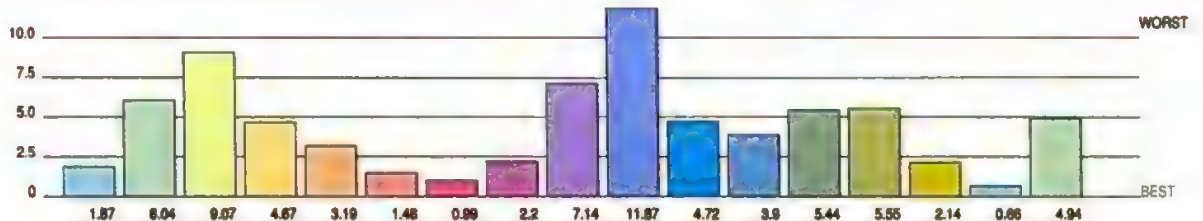
Elapsed Time (seconds)



Elapsed Time (seconds)



Elapsed Time (seconds)



NEC ProSpeed 386 Laptop Computer (16 MHz)
Data World Portacom 386-20 (20 MHz)
Maxtron LCD Portable 386 (20 MHz)
PC Brand 386/25 (20 MHz)
Dolch P.A.C. 386-20 (20 MHz)
Compaq Portable 386 (20 MHz)
IBM PS/2 Model 770 386 (20 MHz)
Pan United Micro Labs 386/20L (20 MHz)
Toshiba T3200/100 (20 MHz)
Micro Telelec 386 Portable (20 MHz)
PC Brand 386/25 Portable (25 MHz)
Tangent Express Regal II (25 MHz)
Micro Express Regal II (25 MHz)
Dolch P.A.C. 386-25C (25 MHz)
IBM PS/2 Model 70-421 (25 MHz)
National Micro Systems Gas Plasma 386-25 (33 MHz)
Blue Max Attache 386 (33 MHz)

* Reported for comparison.

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PROCESSOR, MEMORY, AND DISK BENCHMARK TESTS: COMPOSITE VIEW

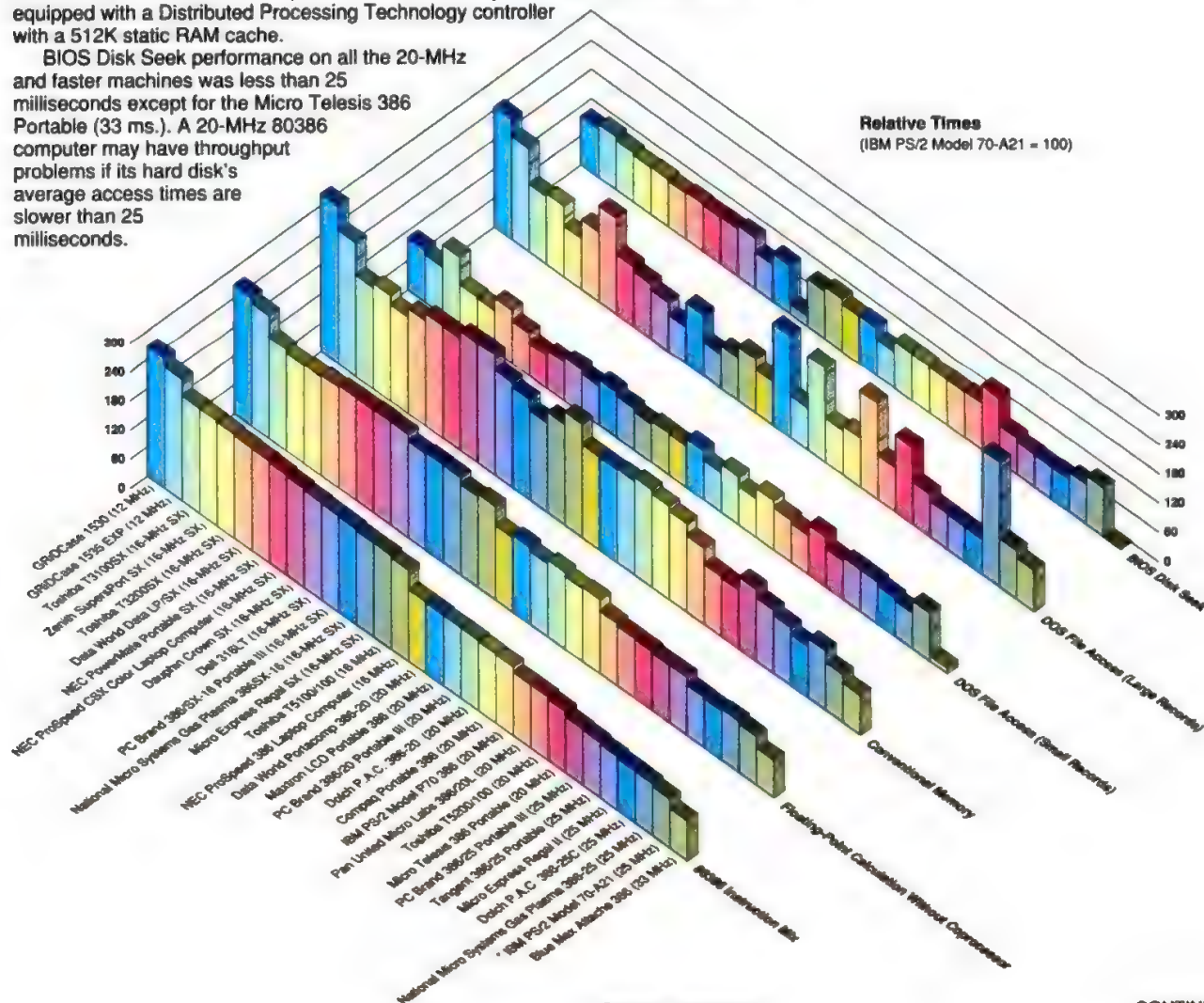
These results demonstrate the wide spectrum of performance within the 80386 and 80386SX family of portable computers. Within the memory and processor benchmark tests, these portables separate themselves out according to clock speed. The best examples of this rule can be found within the SX machines, where the 80386 Instruction Mix and Floating-Point Calculation results fall within a narrow spread. The two 16-MHz 386s, the Toshiba T5100/100 and the NEC ProSpeed 386 Laptop Computer, are marginally faster due to the wider 32-bit data bus all 80386-based PCs employ. The Micro Telesis 386 Portable and the Toshiba T5200/100 are the fastest-performing 20-MHz portables, with the speed gain coming from the significantly faster memory performance, as well as from the T5200's 32K processor RAM cache. Among the 25-MHz machines, the National Micro Systems Gas Plasma 386-25 achieves the fastest scores largely because of a generous 64K cache of fast 25-nanosecond cached memory.

Hard disk performance is consistent throughout the field with the exception of the Toshiba T3100SX (slow) and International Instrumentation's Blue Max Attache 386 (fast). According to Toshiba, the JVC 40MB hard disk found in the T3100SX did poorly on the small-record DOS File Access benchmark test because the JVC drive is a low-power unit that rotates its platters more slowly than conventional drives. This helps give the T3100SX a battery life of 2.5 hours, though, and the unit's large-record DOS File Access and BIOS Disk Seek performance results are comparable to those of other machines in this roundup.

The Blue Max Attache 386's hard disk screamed by the other disks reviewed here because of a cached controller placed on its full-size system board. The Blue Max came equipped with a Distributed Processing Technology controller with a 512K static RAM cache.

BIOS Disk Seek performance on all the 20-MHz and faster machines was less than 25 milliseconds except for the Micro Telesis 386 Portable (33 ms.). A 20-MHz 80386 computer may have throughput problems if its hard disk's average access times are slower than 25 milliseconds.

The IBM PS/2 Model P70 386 and Zenith SupersPort SX do not permit system BIOS shadowing to be disabled. All other units were tested with processor RAM cache enabled and all BIOS shadowing disabled.



* Reported for comparison.

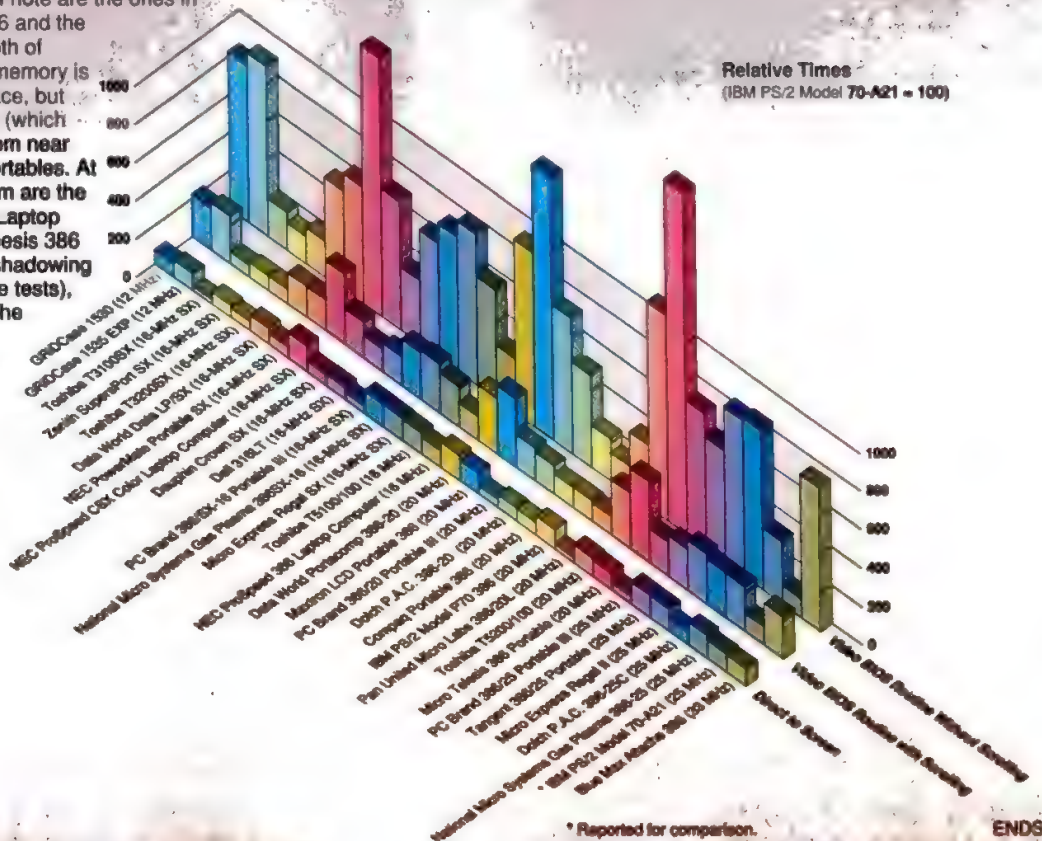
CONTINUES



VIDEO BENCHMARK TESTS: COMPOSITE VIEW

The fastest video times among 386 and SX portables were turned in by those machines that incorporate their video controllers into their system boards. At the head of the pack were the Toshiba T3100SX and T3200SX, with the T3100SX the fastest in two of the three tests. Both machines employ the Paradise PVGA chip set and access the video display memory and video BIOS via a 16-bit interface.

Other video controllers of note are the ones in the IBM PS/2 Model P70 386 and the Compaq Portable 386. In both of these systems, the display memory is accessed via an 8-bit interface, but their video BIOS shadowing (which cannot be disabled) puts them near the top of the heap for all portables. At the other end of the spectrum are the NEC ProSpeed CSX Color Laptop Computer and the Micro Telesis 386 Portable. With video BIOS shadowing disabled (as called for by the tests), the active matrix display in the CSX requires extra processing to keep the screen filled with information. The Prism EGA board in the Micro Telesis system displayed inefficient video BIOS coding, although its video memory ran as expected for an EGA display controller.



You will need an AC outlet near you at all times. There is no battery pack for the CSX—not with a power-hungry color display to drive. At 18.5 pounds, the task of carrying the unit is not terribly arduous, but this is no lightweight machine. Unfortunately, the CSX sports an unwieldy, flimsy, jiggly monster of a handle that protrudes from the front of the machine.

The CSX keyboard may well be the best keyboard I've ever come across on a portable machine. There is a separate cursor/numeric keypad, the keys are uncrowded, and there is a solid though inaudible click associated with each key. It's an absolute pleasure to use—not a single missed keystroke to be found anywhere. My only complaint concerns the missing Plus/Minus and Enter keys usually found on the far right of most keyboards.

Now—on to the color display. It just isn't there yet. It's color, all right, and

sometimes some of the colors are actually intense enough to be usable. But for the most part, we are talking about a display that is slow, very difficult to see, and washed out. As far as I'm concerned, it is unusable for any real work.

The display includes brightness and contrast knobs, though they really work only in the upper 25 percent of their operating range. Any lower than that and the display becomes unusable. When using a program in monochrome, I was never able to find a happy medium between foreground and background contrast. It was not possible to get good, solid white and black. When using any color program, the only way to obtain relatively intense colors and a decent background was to tilt the screen back severely. At such an angle, the top two-thirds of the screen are visible, but move your head to see the bottom third and the top disappears.

Even worse, with color programs, the screen was often unstable, showing all sorts of miscellaneous problems, from significant flicker to strange shadowing and ghosting. Vertical color bleeding and blotchiness—problems found in our First Looks prototype—have still not been resolved. Animation—and, therefore, most any game—is not a viable option on this machine. Even *Tetris*, a fairly uncomplicated animated game, is difficult to play for beyond 8 or 10 minutes. Typical business charts look OK, but they are not of a quality suitable for business presentations. There is simply no satisfactory way of taking in the entire screen.

What does \$8,500—give or take a few bucks—buy you? Attach an external VGA monitor and it gets you an incredibly expensive 386SX machine with a great keyboard. At this price the machine should be solid—there is no room for even seeming-

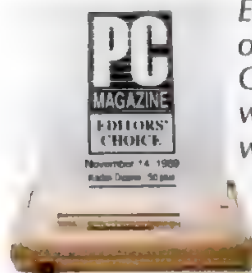
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PORTABLES 386- AND 386SX-BASED



FACT FILE

NEC ProSpeed CSX Color Laptop Computer
NEC Technologies Inc., 1255 Michael Dr., Wood Dale, IL 60191-1094; (800) 826-2255, (708) 860-9500.

List Price: With 2MB RAM, 42MB hard disk, 1.44MB 3.5-inch floppy disk drive, EGA 16-color (double supertwisted nematic backlit LCD) display, one serial and one parallel port, DOS 3.3, Microsoft Windows/386 2.1, PowerMate Hardware Utilities floppy disk, \$8,499; with 1.2MB 5.25-inch floppy drive \$8,898.

In Short: The first portable to boast a color LCD display. A competent, 16-MHz 386SX based machine with a great keyboard and a promising, first-generation color display that is not yet ready for prime time.

CIRCLE #15 ON READER SERVICE CARD

ly trivial problems such as flimsy handles and expansion covers.

Use the NEC ProSpeed CSX Color Laptop Computer with its own color display and you can boast of being the first on your block to have such a thing—but that's

about all you'll be bragging about. Color on a portable won't stay this way for long; we will soon see some mighty impressive things from the color laptop world, and I look forward to NEC's follow-up to the current CSX. For now, admire the technology but save the dollars.

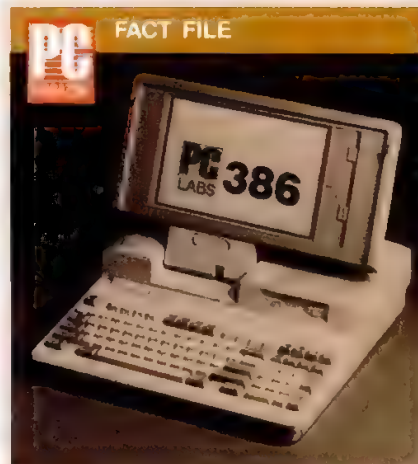
NEC TECHNOLOGIES INC.

NEC ProSpeed 386 Laptop Computer

by Tony Rizzo

One of the few portables that support an optional docking station, the 16-MHz NEC ProSpeed 386 Laptop Computer's strength lies in its ability to serve as both a portable and a desktop machine. The good news is that the ProSpeed meets this two-tiered goal admirably well.

The ProSpeed/docking station combination easily matches the typical 16-MHz desktop machine. The ProSpeed provides an LTX expansion slot, a 1.44MB 3.5-inch floppy disk drive, a 42MB hard disk, built-in EGA graphics and VGA text support, 1MB of ROM, up to 10MB of RAM on proprietary cards, and a proprietary slot for a 2,400-bit-per-second modem. Externally, the ProSpeed provides a VGA CRT port, a serial port, and a parallel printer port. The docking station adds three AT-



FACT FILE

NEC ProSpeed 386 Laptop Computer

NEC Technologies Inc., 1255 Michael Dr., Wood Dale, IL 60191-1094; (800) 826-2255, (708) 860-9500.

List Price: With 2MB RAM, 42MB hard disk, 1.44MB 3.5-inch floppy disk drive, EGA 16-color backlit liquid crystal display, one serial and one parallel port, DOS 3.3, VM/386 multitasking control program and utilities, TELCOM communications software, \$6,599; with 4MB RAM, \$7,898. Docking station, \$999.

In Short: A versatile, solid, 386-based laptop, fully capable of serving as a desktop unit when NEC's optional docking station and a VGA monitor are attached. The excellent display does a good job with most software, including Microsoft Windows.

CIRCLE #14 ON READER SERVICE CARD

compatible slots, an XT-compatible slot, room for two additional half-height drives, a second serial port, an external keyboard connection, and a power supply to drive it all. The docking station is sturdy enough to support a typical 14-inch VGA monitor,

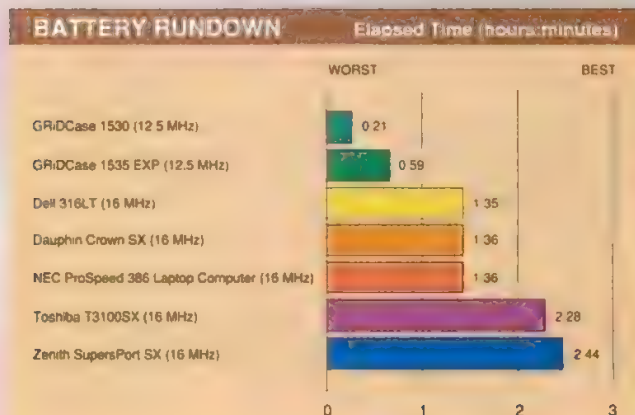


PERFORMANCE TESTS: 386- AND 386SX-BASED PORTABLES

Only seven of the 386-based systems we tested were battery-operated, with operating times ranging from 21 minutes on the older GRiDCase 1530 to 164 minutes for the Zenith SupersPort SX.

The GRiDCase 1530 drives a full-power 8.75 by 5.75 CGA gas plasma display, which can consume as much as 30 watts. With its 1.7-Amp/hour battery and 2MB RAM, we were not surprised that battery life was only 21 minutes. By comparison, the Toshiba T3100SX also features a gas plasma display, but its VGA screen is a new 4-watt unit that conserves battery power. Liquid crystal displays are used in the remaining machines, including the Zenith SupersPort SX with its 12V 4Ah battery, which requires only 3 hours for recharging.

The **Battery Rundown** performance test involves teletyping five screens of text to the laptop computer's display, then writing a 15K file to the hard disk once every minute until the battery runs out of power. All power conservation techniques are disabled.



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and it is very easy to add expansion boards.

People who've seen the docking station laugh at its size. But in fact, with the ProSpeed mated to the docking station, its footprint measures 21 inches wide by 25 inches deep—just about the size of an IBM AT and keyboard. (An external keyboard would add to this space, but the ProSpeed keyboard is good enough for me.) Certainly a small-footprint desktop machine would take up less space, but you couldn't take the desktop machine with you wherever you go.

How does the ProSpeed stand on its own? As a portable, it's excellent. At 16 MHz, it's not a serious CADD-level machine—but for most business applications, and for most programming work, it is plenty fast. Most 386 machines we tested run at either 20 or 25 MHz, but a look at the benchmark tests will show that the ProSpeed more than holds its own.

The best part of the ProSpeed is its removeable backlit display—the best I've seen on any 386 portable. Only the Compaq SLT/286 (a 286-based machine reviewed in the 286 section of this issue) has a better display. Completely legible and highly visible even at a distance of 4 to 5 feet, it offers solid, crisp black letters on a fine paper-white background, as well as eight shades of gray. Word processing, database, and spreadsheet applications are all well served by the ProSpeed's display.

One word of caution here, however. While the built-in adapter for use with an external monitor is a true VGA, the laptop display supports only VGA-quality text and EGA-quality graphics. True VGA resolution would be better still. It's also a bit slow; animation won't have the crisp feel you may be used to seeing on a regular monitor.

As for portability, at 17.5 pounds the ProSpeed is neither heavy nor light. With its battery pack (or battery "slice," as NEC calls it), its weight jumps to 22 pounds. But slip the machine into its slick black-leather case and carrying it becomes a piece of cake. I've used the ProSpeed with the battery, without turning on any of the ProSpeed's power-saving options (for example, shutting down the hard disk when it is not being used), and managed to get just over 2 hours on a full charge.

Complaints or caveats? The modem is very difficult to install, requiring that both the keyboard and upper cover of the ProSpeed be removed. NEC suggests that you let your dealer handle this, though I've managed to do it myself.

386- AND 386SX-BASED

If it's important that your portable be able to fully duplicate the functionality of a desktop machine, the NEC ProSpeed 386 Laptop Computer is for you. For just about all standard business applications, it's at the head of the class—whether on the desktop or on the road.

PAN UNITED CORP.

Micro Labs 386/20L

by Mitt Jones

Pan United's Micro Labs 386/20L is one of a slew of low-cost 386 gas plasma lunchbox machines hitting the market. Unfortunately, the machine's price—\$4,026 with 2MB RAM, a 20MB hard disk, and DOS 3.3—is above that of much of its low-cost competition, and this sloppily engineered machine fails to justify its additional cost.

The AMI motherboard—a solid, well-known component—makes room for one 8-bit slot, four 16-bit slots, and a high-speed 32-bit memory slot. Unfortunately, the 386/20L manages to block or use every slot. The I/O board occupies the 8-bit slot, and the VGA adapter and the disk control-

ler occupy two of the 16-bit slots. The power supply covers one 16-bit slot and nearly covers another—leaving too little room for the hard disk controller connections. Even positioned in the next slot over from the power supply, the controller's connectors extend over the back of the empty slot, preventing installation of even a half-length 8-bit card.

The 386/20L's most visible failing lies with its display. Whether it's the fault of the 16-bit Ahead Technologies VGA adapter or the screen itself, the system did poorly with our graphics test images. The results of our attempts to translate 256-color Colorix images into 16-shade images were miserable. The system fared better with 8- and 16-shade images, but even here image quality was well below par.

Text-mode characters were readable, but even with the screen's one control set for the highest level of brightness, the characters still didn't stand out clearly from the dark orange background. This was especially noticeable in direct comparison with other gas-plasma-display machines. The 386/20L's screen simply isn't bright enough.

Less-serious complaints center on the keyboard. For starters, the connector lies at bottom center of the left side of the machine, which means you'll face the irritation either of unplugging the keyboard when you want to close the system or of leaving a loop of cable hanging out of the box. And the awkward 101-key keyboard takes a bit of getting used to, especially if you want to use the 12 function keys stacked in two rows along the top left side of the keyboard. The cursor keys lie at the top of the keyboard toward the right. In a final twist on tradition, the Escape key is located at top center.

Ultimately, there is nothing terribly wrong with the Micro Labs 386/20L. Our evaluation unit came with a 42MB Seagate ST-151 hard disk and a National Computer ST-506 subsystem, a solid if unspectacular combination. The 64K 25-nanosecond static-RAM cache and AMI cache logic earned the system high marks on memory-intensive chores.

Indeed, as we noted in the December 12, 1989, issue, many of the components are PC standards. If you rarely use graphics and require no expansion slots, the 386/20L will probably suit your needs. On the other hand, given this machine's lack of attention to engineering detail, you ought to consider less-expensive, better-performing alternatives.



Micro Labs 386/20L

Pan United Corp., 1967 Route 27, #12, Edison, NJ 08817, (800) 433-3006, (201) 985-8009
List Price: With 1MB RAM, 64K memory cache, 1.44MB 3.5-inch floppy disk drive, VGA gas plasma display, one parallel and one serial port, \$3,529; with 2MB RAM, 20MB hard disk, DOS 3.3, Disk Manager software, \$4,026; with 1MB RAM, 42MB hard disk, 1.2MB 5.25-inch floppy disk drive, \$4,226

In Short: A lackluster gas plasma display and lack of available expansion slots detract from the attractiveness of this otherwise-solid 20-MHz lunchbox machine.

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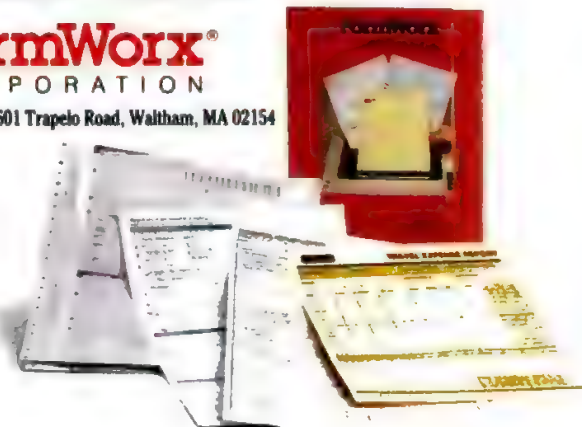
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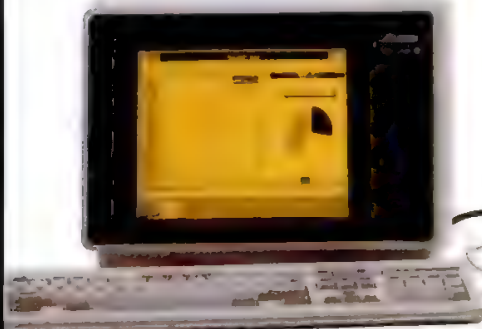
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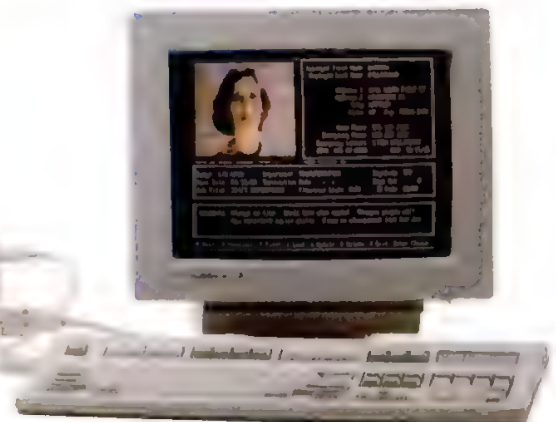
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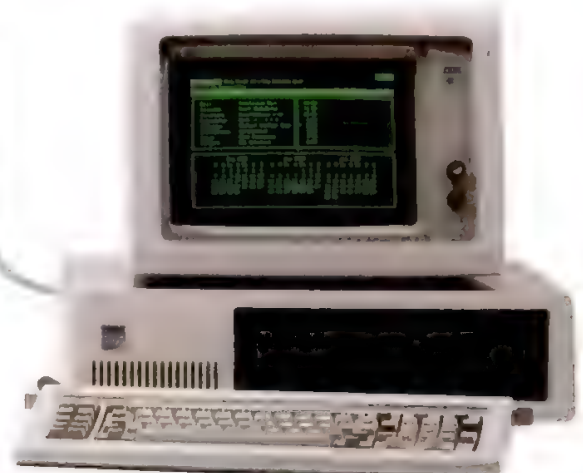
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PC BRAND INC.

**PC Brand 386/SX-16
Portable III**

by M. David Stone

The PC Brand 386/SX-16 Portable III could be the twin to any other PC Brand lunchbox portable. Put it next to the other PC Brand systems reviewed in this issue and it will literally get lost in the crowd. But it stands out on the PC Labs benchmark tests, where it was consistently one of the top performers among 386SX portables.

The system provided for review is priced at \$5,438, which is about two and a half times the base price for the unit. Among the options that drove the price up were a 17-millisecond MiniScribe 150MB hard disk, a 16-bit VGA card from Advanced Technology Information Systems, a math coprocessor, and a gas plasma display. The review unit also came with 5MB of RAM, DOS 4.01, and both a 1.2MB 5.25-inch floppy disk drive and a 1.44MB 3.5-inch drive.

The overall physical design is typical for lunchbox computers—and identical to its siblings'. The system weighs in at a lug-gable 24 pounds and measures 10.5 by 16 by 8.75 inches (HWD).

Inside the box, largely hidden by the disk drives and 180-watt power supply, you'll find a PC Brand motherboard with an AMI BIOS and a Chips and Technologies chip set. The motherboard also has room for up to 16MB of memory, using SIP modules. The SIP modules in the review machine were a mixture of 80-nanosecond modules and 100-ns. modules, an unusual feature. According to PC Brand, this creative combination is not typical. While the system normally ships with 80-ns. chips, 100-ns. chips were used in the tested unit in order for the machine to meet the shipping deadline for inclusion in this roundup.

The PC Brand motherboard has eight slots. Five of these are available, but only one allows for a full-length board. On the review system, this was filled with the Adaptec controller with 16K cache.

The four other slots are limited by the disk drive bays. Two of these can handle three-quarter-length cards. The other two can only take cards that are no longer than a 16-bit slot. On the review system, two of the four were filled with the VGA card and

a serial/parallel card, with ribbon cables connected to the 25-pin serial and parallel ports on the back panel of the system. Be forewarned that even though there are two slots still open, you may have trouble using them, since various cables may get in the way.

On the PC Labs tests, the gas plasma display showed 16 shades of gray. As expected, this yielded an acceptable image for the 16-shade picture, while the 64-shade picture was unrecognizable. The screen is acceptable for text but could be improved with more contrast.

As with other PC Brand systems, the 386/SX-16 Portable III comes with a five-year diminishing warranty.

Overall, the PC Brand 386/SX-16 Portable III is an uneven mix, with some marginal shortcomings—like the keyboard and the screen—balanced by some praiseworthy features—like the 3.5-inch drive bay for a second floppy drive, the solid performance on our benchmark tests, and the relatively low price. It can't be recommended unreservedly, but it's still worth a look.

**PC Brand 386/SX-16 Portable III**

PC Brand Inc., 954 W. Washington St., Chicago, IL 60607; (800) PC BRAND, (312) 226-3500.

List Price: With 1MB RAM, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, CGA backlit liquid crystal display, one serial and one parallel port, utilities, carrying case, \$2,045; with 2MB RAM, 40MB hard disk, DOS 4.01, \$2,759; with VGA gas plasma display, 5MB RAM, 150MB hard disk, both floppy disk drives, 80386SX 16-MHz coprocessor, \$5,438.

In Short: The PC Brand 386/SX-16 Portable III offers solid 386-SX performance, a relatively low price, and some noteworthy features, like the 3.5-inch bay for a second floppy disk drive. But there are also some shortcomings, like a gas plasma screen that shows less contrast than it might.

CIRCLE 416 ON READER SERVICE CARD

PC BRAND INC.

**PC Brand 386/20
Portable III
PC Brand 386/25
Portable III**

by M. David Stone

Depending on your point of view, the PC Brand 386/20 Portable III and 386/25 Portable III are either two closely related computer systems or two variations on one computer. As the model names indicate, the key difference between the two is CPU speed. And in fact, according to PC Brand, the two units are essentially identical, differing only in one crystal, the CPU, and one additional chip.

The price difference between the systems as tested is a scant \$280—at \$6,356 for the 386/20 and \$6,636 for the 386/25.

As tested, both systems came with DOS 4.01, 8MB of 80-nanosecond RAM, a MiniScribe 150MB hard disk, a 16-bit VGA card from Advanced Technology Information Systems, an 80387 math coprocessor, and both a 1.2MB 5.25-inch floppy disk drive and a 1.44MB 3.5-inch drive. The availability of both floppy disk sizes is a nice touch. Indeed, it almost rates as a luxury in a lunchbox luggable.

The overall physical design of the units is fairly standard, with the detachable keyboard serving as a cover for the screen during transport. Also standard are the footprint—10.5 by 16 by 8.75 inches (HWD)—and the 25-pound weight. As with most lunchbox systems, the screen tilts separately from the rest of the unit for better viewing. The Chicony-built keyboard offers an audible click and clear kinesthetic feedback, though the layout is a potentially confusing cross between the original AT layout and the Enhanced-style keyboard.

Inside both units you'll find a PC Brand motherboard with an AMI BIOS and a Chips and Technologies chip set. All memory—up to 16MB—goes on the motherboard in SIP modules. The tested systems sported four modules of 2MB each.

The motherboard has eight slots, though three are hidden by the 180-watt power supply. Of the five remaining, only one allows for a full-length board. The others are limited by the disk drives, with room for two three-quarter-length cards



PC Brand Inc., 954 W. Washington St., Chicago, IL 60607; (800) PC BRAND, (312) 226-3500.

PC Brand 386/20 Portable III

List Price: With 1MB RAM, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, CGA backlit liquid crystal display, one parallel port and one serial port, utilities, carrying case, \$2,495; with 2MB RAM, 40MB hard disk, DOS 4.01, \$4,125; with 8MB RAM, 150MB hard disk, both floppy disk drives, VGA gas plasma display, 80387 20-MHz coprocessor, \$6,356.

PC Brand 386/25 Portable III

List Price: With 1MB RAM, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, CGA backlit liquid crystal display, one parallel and one serial port, utilities, carrying case, \$2,695; with 2MB RAM, 40MB hard disk, DOS 4.01, \$4,349; with 8MB RAM, 150MB hard disk, both floppy disk drives, VGA gas plasma display, 80387 25-MHz coprocessor, \$6,636.

In Short: Like other PC Brand lunchbox systems, the 386/20 Portable III has some shortcomings, like a gas plasma screen that shows less contrast than it might and a potentially confusing keyboard layout. But it also boasts some noteworthy features, like the 3.5-inch drive bay for a second floppy disk drive. Most important is a price low enough that you may be willing to accept a few compromises. Just \$280 more, the 386/25 Portable III is essentially the same system with a faster processor.

CIRCLE 421 ON READER SERVICE CARD

and two cards that are no longer than a 16-bit slot.

In the review systems, the full-length slot was filled with an Adaptec disk controller with a 16K disk cache. Two other slots were filled with the VGA card and a serial/parallel board, with ribbon cables running to the 25-pin serial and parallel ports on the back panel. Still open were one 16-bit slot and one 8-bit slot. However, the combination of limited length and lots of cables makes for a tight fit if you plan to add any additional boards.

One notable feature is a card that sits physically on the drive bays and electrically between the video card and the gas plasma display. The card converts standard VGA output into a signal appropriate for

PORTABLES 386 AND 386SX-BASED

the screen. By supplying the converter as a separate card, PC Brand lets you use any VGA card on the market, rather than tying you to a special video card as some similar systems do.

On PC Labs tests, the display on both systems showed 16 shades of gray, but with little differentiation among the brighter shades. As expected, this translated in our tests into an unrecognizable image in 64 shades of gray and an acceptable image in 16 shades. For text, I'd like to see more contrast, but the screens are certainly acceptable as is.

One last item worth mention is the PC Brand warranty, which includes 100 percent parts coverage and on-site service for one year, then drops back to 80 percent for parts only for the second year, 60 percent parts for the third year, and so on, down to 20 percent parts coverage for the fifth year. For an extra charge, you can convert this to full coverage with on-site service.

Overall, the PC Brand 386/20 Portable III and 386/25 Portable III lack the careful fit and finish of, say, the Dolch P.A.C. 386-25C. But then again, they have a far lower price tag. If price is an issue, then PC Brand may well offer the bargain you're seeking.

TANGENT COMPUTER INC.

Tangent 386/25 Portable

by Bill O'Brien

Although tons lighter than the old Compaq "luggable" and light years more advanced, the \$5,295 Tangent 386/25 Portable still epitomizes that same "just put it in a smaller case" philosophy.

You or I could purchase many of the components found in the Tangent. The case, screen, and keyboard—good choices all—are from Chicony. EGA video, supplied by a Wang An Ya board using a proprietary chip set and displayed on the monochrome gas plasma screen, provides crisp graphics and readable text. Glare was minimal even under the high-power fluorescents in PC Labs.

The heart and soul of this Tangent is its Data Expert motherboard, with an AMI BIOS and a Chips and Technologies chip set. Even utilizing as many VLSI and surface-mount devices as possible, the price



Tangent 386/25 Portable

Tangent Computer Inc., 303 Beach Rd., Burlingame, CA 94010; (800) 223-6677, (415) 342-9388

List Price: With 512K RAM, 20MB hard disk, 1.44MB 3.5-inch floppy disk drive, CGA liquid crystal display, one parallel and two serial ports, \$1,995; with 2MB RAM, 40MB hard disk, EGA liquid crystal display, DOS 3.3 or 4.01, \$2,650; with 8MB RAM, 135MB hard disk, EGA gas plasma display, \$5,295.

In Short: An excellent contender with good performance, the Tangent 386/25 Portable is a bright spot as big as its base system's price is small.

CIRCLE 400 ON READER SERVICE CARD

Tangent pays for using this motherboard is the loss of access to three of its eight slots. The two 8-bit and the single 16-bit connectors are blocked by the 150-watt power supply.

Some compensation is afforded by the two proprietary 32-bit slots, both of which will do double duty as 16-bit slots if you're not using them for memory expansion. That's a reasonable premise, considering that the motherboard will handle 8MB of SIMMs (our test machine came with a full complement of NEC 80-nanosecond devices) and a single Data Expert add-in memory board will give you room for an additional 8MB.

The CDC 135MB hard disk, attached to a DTC ESDI controller, was formatted with a 1:1 interleave, and the drive danced through the large-record DOS File Access test, delivering low numbers indicative of fast program-loading ability (large blocks of data should also be no chore). Small Record results, which typically emulate raw data record-handling speed, were not as impressive but were by no means the slowest of the group.

Disappointingly, the Tangent's processing performance was not exceptional. In fact, both Instruction Mix and Conven-

Before you make any big decisions over which laser printer to buy, we'd like to point out a few little things about the new Canon LBP-4.

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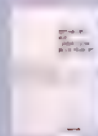
And it's the only laser printer in its class to offer built-in scalable fonts that let you set type from the smallest fine print to headline size. Without options or add-ons.

Plus a lot of other little extras that make it easy to print high-quality text and graphics right down to the smallest detail. Including Canon's convenient EP-L replaceable cartridge, and a versatile front-loading paper tray. It even prints envelopes.

Very little to get excited about.

So call toll-free 1-800-441-5454 or stop by your Canon Dealer and see an LBP-4 for yourself.

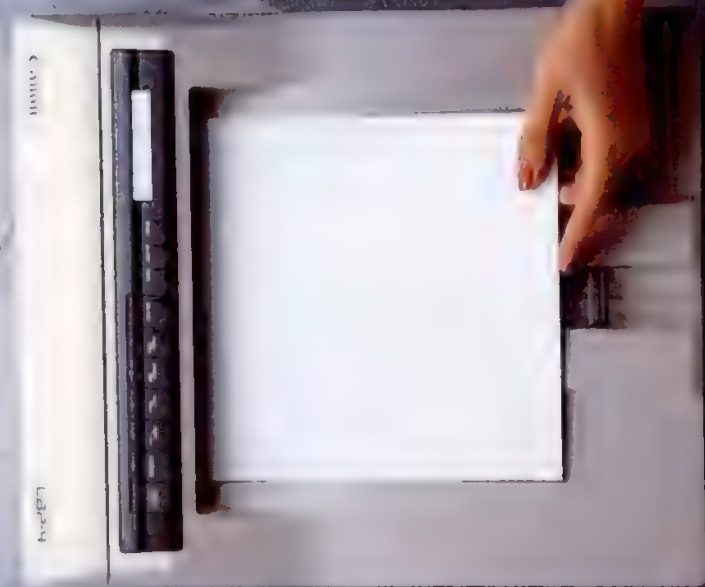
It's the first compact, affordable laser printer with scalable fonts, standard. And that's something to get excited about.



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tional Memory benchmark tests place it at the tail end of the 25-MHz computers. Yet, as with many of the 80386 portables, Tangent has foregone the speed advantage of expensive static RAM caches in order to maintain a low price. Its video numbers highlight the most impressive performance found in the machine.

Because the machine currently holds an FCC Class A rating, it is suitable only for commercial environments. Yet, as a portable network hookup, it may be ideal. There's no difficulty outfitting the Tangent 386/25 with an internal modem or network card. Tangent offers a variety of modems that range from those with Hayes compatibility to a claimed 19-kilobit-per-second Microcom unit using the MNP transfer protocol. Tangent sells Ethernet or Token-Ring network boards to fill that last slot—there's even an Emerald 5250 emulation card—and Tangent claims its products are compatible with a wide variety of third-party networking topologies.

The price of our beefed-up version of the Tangent 386/25 is competitive, but if you're just looking for a take-along you can plug into your network back at the office or on the road, consider the low-end version of this machine. With a base price of \$1,995 for 512K and a 20MB hard disk, topping the memory to 2MB should still bring it in under \$2,400. And even an 80387 for those number-crunching road trips will add only \$525 to the base price.

Ultimately, the Tangent 386/25 Portable probably won't blow anyone's doors off, but it is a well-conceived, well-implemented system. If you're in the market for an inexpensive 25-MHz luggable, this one's certainly worth your consideration.

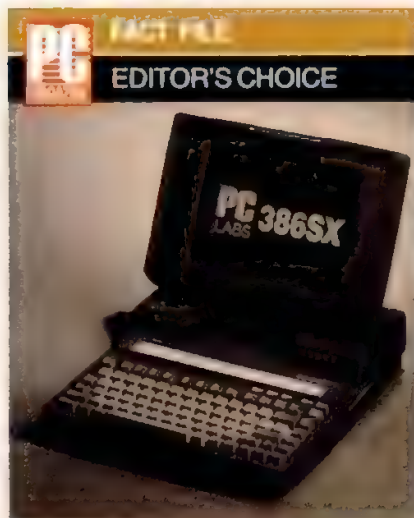
TOSHIBA AMERICA INFORMATION SYSTEMS INC.

Toshiba T3100SX

by Matt Ross

The first features you'll notice about Toshiba's small, light T3100SX are its large, bright VGA gas plasma display, an overwhelming bank of ten LED indicators across its midsection, and its ponderous price tag. More importantly, this \$5,999 portable with 1MB RAM, 40MB JVC hard disk, a 1.44MB 3.5-inch floppy disk drive, and DOS 4.01 travels untethered from AC power—offering more than 2 hours of battery life between recharges.

Using new display technology, the



Toshiba T3100SX

Toshiba America Information Systems Inc., Computer Systems Division, 9740 Irvine Blvd., Irvine, CA 92718-9724; (800) 334-3445, (714) 583-3000

List Price: With 1MB RAM, 40MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA gas plasma display, one parallel and two serial ports, utilities, DOS 4.01, \$5,999; with 3MB RAM, \$7,098

In Short: The T3100SX is an exceptional clamshell 15-pound 386SX laptop. It offers the first battery-powered gas plasma display, good features, reasonable battery performance, and a high price tag.

CIRCLE 417 ON READER SERVICE CARD

14.6-pound T3100SX has a bright orange display that pulls only three or four watts of power from the system, unlike standard AC-powered plasma displays that need as much as 30 watts to function. The large 7.75- by 5.9-inch display creates crisp images without the flicker or ghosting of liquid crystal units.

Further inspection of the unit reveals no manual brightness or contrast controls; however, Toshiba implements a smart display optimized for text applications. For graphics, Toshiba provides its own VGA Change Display utility (VCHAD), which gives you complete control over all gray-scaling and can be pulled up in the middle of any application with the Alt-SysReq key combination.

The T3100SX also provides a handy pop-up utility to control battery conservation techniques. Hitting Fn-PopUp opens a window that indicates the remaining battery life and allows you to choose Toshiba's handy resume feature. This lets you power-on the T3100SX in the middle of any previous application you were working with. Also at your disposal are display

and hard-disk power-saving options, as well as a user-selectable low battery alarm. Another alarm indicating that you have closed the laptop with the power still on is also included.

These utilities work in conjunction with the ten LED indicators, the left and right battery indicators being the most useful. Depending on the batteries recharging, the LEDs glow amber, shine bright green when driving the system, turn red when nearly drained, and are inactive when the other battery is running the system.

The transformer adds an additional 1.7 pounds to the unit and recharges the two nickel cadmium cells in 3 hours. On the PC Labs battery rundown test, the T3100SX lasted a respectable hour and 45 minutes. This is a worst-case scenario (without any of the system's conservation techniques enabled), so normal use should give you well over 2 hours of continual computing. Toshiba sells an external charger complete with a second AC transformer for \$399, while additional nickel cadmium batteries cost \$129.

The 3- by 12- by 14-inch (HWD) system has its handle at the back; the handle also serves as a rear leg to tilt the unit to a comfortable typing angle. When closed, the handle smartly covers the external VGA, parallel, and two serial ports, as well as the 16-bit proprietary slot. A dedicated modem slot is located on the underside of the unit for Toshiba's 2,400-bit-per-second internal modem.

The 86-key keyboard is reasonably well designed with separate cursor keys, 12 function keys across the top, and the built-in pop-up utility keys previously mentioned. Also, processor speed can be toggled easily between 8 and 16 MHz. The key action is good, and the Alt, Shift, Enter, and Backspace keys are oversized.

Internally, the system comes standard with 1MB of 80-nanosecond 4-by-256Kb chips. Memory expansion to 7MB or 13MB is possible using either 2MB or 4MB memory modules. The T3100SX uses Toshiba's own 386 chip set and supports an 80387SX coprocessor. The unit comes complete with a JVC 40MB hard disk that uses RLL encoding and a high-density 3.5-inch floppy disk drive.

On the PC Labs benchmark tests, the T3100SX's hard disk performed reasonably well but was not among the fastest tested. The same is true of the processor and memory. Video scores were exceptional thanks to the 16-bit Paradise chip set. The T3100SX further distinguishes it-

self as a video star with the added feature of simultaneous support of both the internal display and an external VGA monitor.

Overall the T3100SX is in a class by itself for portable 386 computing. Its small size, exceptional video, and amount of user control make this an attractive laptop. Its \$5,999 price tag is intimidating and expansion is limited, but if portable 386 power, good battery life, and VGA are what matter, this is the machine for you.

TOSHIBA AMERICA INFORMATION SYSTEMS INC.

Toshiba T3200SX

by Matt Ross

Toshiba's new T3200SX is positioned as a desktop replacement for three good reasons. The \$6,299 T3200SX offers a large VGA gas plasma display, a full-size keyboard with 12 function keys and a separate cursor/numeric keypad, and more internal expansion potential than any other Toshiba laptop.

The T3200SX sent to PC Labs lists for \$7,398 with 3MB system memory. Standard features include 1MB RAM, a 40MB hard disk, a 1.44 MB 3.5-inch floppy disk drive, DOS 4.01, disk and expanded memory utilities, and Toshiba's *Hypertext* disk-resident documentation.

The first notable feature is the T3200SX's generous 9- by 6.75-inch gas plasma display. Supporting VGA's 640 by 480 lines of resolution, it is one of the best displays currently available, featuring 16 gray-scale shades, Toshiba's excellent VGA Change Display (VCHAD) utility, and a manual brightness-control knob. The T3200SX simultaneously supports the system display and an external VGA monitor—a feature all portables should possess, but few currently do.

The T3200SX also has an excellent 91-key unit, featuring a dedicated cursor/numeric keypad with a second Enter key. The Ctrl, Alt, Shift, Backspace, CapsLock, Ins, and Enter keys are all oversized. Key action is excellent, and unlike the situation with many laptops, you won't need to search for any keys; they're where you expect them to be.

The T3200SX's expansion possibilities allow for a 16-bit industry-standard architecture (ISA) card (perfect for networks), and either a half-length 8-bit ISA card or a Toshiba 16-bit card. However, these two slots are so close together that you can only

use one. To reach the slots you must remove first a plastic faceplate, then two steel ones, as well as eleven screws. This elaborate procedure is bothersome but straightforward, and the steel plates add support to a durable system.

The unit also accepts a \$349 internal 2,400-bit-per-second modem in a dedicated slot on the underside of the case, or Toshiba's expansion chassis, which connects to the proprietary 16-bit slot to provide five additional 8-bit ISA slots.

The T3200SX is a large machine, and its 3.9- by 14.6- by 15.6-inch measurements (HWD) equal those of its 20-MHz 386 sibling, the T5200. However, at 17.2 pounds, the T3200SX has knocked more than 2 pounds off the weight of its sibling. The T3200SX isn't the most portable laptop, but Toshiba intends it for users who plan to purchase only one computer and require both expansion and portability.

Two serial ports and a parallel/external floppy disk drive port are located at the back, as well as an external VGA monitor connector and the power switch. An auto-sensing power supply for both U.S. and overseas use drives the system without

your having to set any switches, and a comfortable handle swings out from underneath the keyboard.

Removing the keyboard gives you access to the 80387SX/16 coprocessor socket and system memory. The first megabyte of memory comprises 80-nanosecond 4-by-256Kb chips; additional SIMM memory is easy to install, up to a maximum 13MB.

The T3200SX's performance on the PC Labs benchmark tests was good overall, with scores all being well above average on the video benchmark tests. A 40MB IDE Conner hard disk and 16-bit video from Paradise push the T3200SX to the top of its class.

While the test unit did not have the on-line *Hypertext*, Toshiba's comprehensive reference manual, a smaller portable guide, and a guide for beginners are more than adequate. Support includes a toll-free technical phone number and the Toshiba Exceptional Care program, which guarantees 48-hour repair time.

If you are looking for a highly portable machine, perhaps with battery power, the T3200SX is not for you. But if your needs include a keyboard without compromise, exceptional video, and some portability, you can't go wrong with the T3200SX. Its 16-bit slot is perfect for networks, and if the price doesn't scare you away, this could be the only PC you'll ever need.

TOSHIBA AMERICA INFORMATION SYSTEMS INC.

Toshiba T5100/100

by M. David Stone

When it comes to clamshell designs, Toshiba is arguably the best in the business. The company hit its stride with the venerable T1100 Plus and has been going strong ever since. The T5100/100 is solidly grounded in that tradition, offering a 16-MHz 80386 in a highly portable, AC-only, light 15-pound package.

This \$7,499 system has few internal options. Included in the base price are 2MB of RAM, one 1.44MB 3.5-inch floppy disk drive, a 25-millisecond 104MB hard disk, and EGA video with gas plasma display. For connection with the outside world, you'll find one parallel port, one serial port, a DB-9 connector for an external EGA monitor, and a 25-pin connector for an external disk drive. Also included are DOS 3.3, *Microsoft Windows/386* 2.10,



Toshiba T3200SX

Toshiba America Information Systems Inc., Computer Systems Division, 9740 Irvine Blvd., Irvine, CA 92718-9724; (800) 334-3445, (714) 583-3000.

List Price: With 1MB RAM, 40MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA gas plasma display, one parallel and two serial ports, utilities, DOS 4.01, \$6,299; with 3MB RAM, \$7,398.

In Short: The T3200SX is a large AC-powered clamshell 386SX that offers good user-expansion possibilities and a bright VGA plasma display. As a desktop replacement, this one is hard to pass up.

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Toshiba T5100/100

Toshiba America Information Systems Inc., Computer Systems Division, 9740 Irvine Blvd., Irvine, CA 92718-9724; (800) 334-3445, (714) 583-3000.

List Price: With 2MB RAM, 104MB hard disk, one 1.44MB 3.5-inch floppy disk drive, EGA gas plasma display, one parallel and one serial port, utilities, DOS 4.01, Microsoft Windows/386 2.10, \$7,499.

In Short: The 15-pound Toshiba T5100/100 with an EGA gas plasma display is a truly portable 386—albeit battery less. As a 16-MHz system, it may be slower than some of the luggables reviewed here, but the light weight makes it far more likely that you will actually bring it with you.

CIRCLE 419 ON READER SERVICE CARD

PORTABLES 386- AND 386SX-BASED

Quarterdeck's *QEMM-386*, and Multi-soft's *PC-Kwik Power Pack*, with disk caching and other utilities. Note that there are no hard disk options, since the /100 refers to the hard disk capacity.

The display on the T5100/100 is easily adjustable to avoid glare. For text, the contrast and brightness are more than acceptable. One potential problem is that the display has only four shades of gray. Obviously, this can make text unreadable if the system assigns the same shade to both text and background color. However, Toshiba includes a memory-resident utility that remaps the color assignments automatically. In our tests, the utility worked swimmingly.

The built-in keyboard has a smooth yet solid feel and uses a heavily modified version of the original AT layout. The Control and Alt keys are where you would expect them, but the function keys are across the top, with other keys stuck pretty much wherever they fit. This layout yields separate arrow keys but an embedded numeric keypad. Consider it a compromise well worth making in exchange for the small

size: 3.63 inches high by 12.25 inches wide by 14.25 inches deep.

One nice touch on the T5100/100 is a connector for an external keyboard. According to Toshiba, the system will accept any keyboard that works with an AT. When you turn the computer on, it automatically checks to see if a keyboard is plugged in.

For home-base operation, you can also

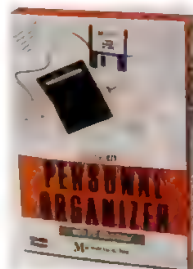
Small size and light weight make the Toshiba T5100/100 ideal for travelling.

add the external 360K 5.25-inch floppy disk drive, as well as the \$1,198 expansion chassis with interface card. The expansion chassis has room for five expansion cards, but the slots are all 8-bit.

Inside the box, the Toshiba mother-

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board sports the Intel chip set, a Toshiba-modified version of the Award BIOS, the Paradise PEGA2 chip, and a socket for an 80387—though you'll have to buy the math coprocessor elsewhere. The 2MB of 80-nanosecond RAM comes in the form of 256-kilobit chips, mounted on modules that are similar to SIMMs but use a proprietary connector. The motherboard also has a connector for a \$1,299 daughterboard with 2MB more of memory, for a system total of 4MB.

The only additional expansion choices within the system are by way of the single 16-bit Toshiba proprietary slot at the back of the unit. If you get the expansion chassis, you'll need the slot for the interface card. Otherwise, you can fill it with a modem card, a Toshiba Ethernet card, or any of several third-party cards for Ethernet, ARCnet, or StarLAN. Be aware that Toshiba sells both a 1,200-bit-per-second modem card for \$349 (don't bother) and a 2,400-bps modem for \$399.

As a 16-MHz system, the T5100/100 doesn't even pretend to compete on performance with the 20- and 25-MHz lunch-box systems in this roundup. What you're paying for here is not power so much as

PORTABLES 20- AND 25-MHz-BASED

portability. The smaller size, significantly lighter weight, and Class B certification from the FCC make the T5100/100 a comfortable traveling companion—which makes it far more likely that you will actually bring the unit with you.

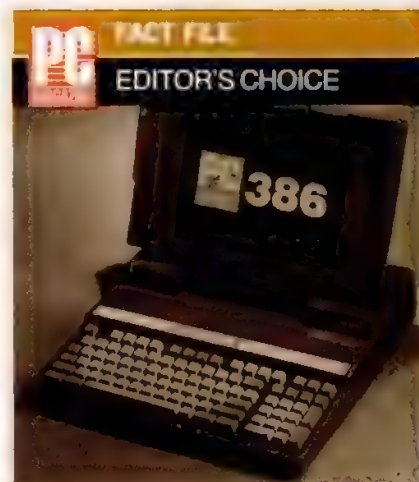
TOSHIBA AMERICA INFORMATION SYSTEMS INC.

Toshiba T5200/100

by Bill O'Brien

Toshiba's 20-MHz, 386-based, AC-powered, \$8,299 T5200/100 may dent your wallet, but it also blurs the distinctions between desktop and portable computer performance.

Along with its 3.5-inch internal floppy disk drive and fine VGA gas plasma display, the T5200/100 arrived for this review packed with a 104MB hard disk. According to a Toshiba representative, the company's new philosophy is to incorporate large hard disks into its entire portable line



Toshiba T5200/100

Toshiba America Information Systems Inc., Computer Systems Division, 9740 Irvine Blvd., Irvine, CA 92718-9724; (800) 334-3445, (714) 583-3000.

List Price: With 2MB RAM, 40MB hard disk, one 1.44MB 3.5-inch floppy disk drive, 32K processor RAM cache, VGA gas plasma display, one parallel and two serial ports, utilities, DOS 4.01, \$7,699; with 104MB hard disk, \$8,299.

In Short: Although pricey, the AC-powered 20-MHz Toshiba T5200/100 with VGA gas plasma display provides desktop performance levels with no compromises to its small size. It would make sense as your only computer.

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Corel Draw! 1.01 (Corel Systems Corp.)	82	2.4/1.0	89	86	84	83	82	83	78	82	79	83	73	81
Arts & Letters Graphics Editor 1.02 (Computer Support Corp.)	80	3.0/1.0	87	80	84	79	78	79	76	82	74	78	90	76
Micrografx Designer 2.0 (Micrografx Inc.)	78	6.3/1.0	84	80	80	77	73	78	78	81	74	74	78	77
Kinetic Art 1.20G (Kinetic Presentations Inc.)	76	11.6/2.0	92	83	80	67	76	64	58	76	87	83	63	78
Artline 1.0 (Digital Research Inc.)	72	3.7/1.0	87	77	81	70	71	69	61	78	66	74	57	67
Adobe Illustrator 88 1.8 (Adobe Systems Inc.)	71	5.8/2.0	83	68	78	73	61	76	70	74	70	62	63	67

Highest Ranking Score!



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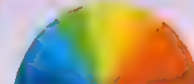
PC Illustration Software	Adobe Illustrator Windows Version 1.0	Arts & Letters Graphic Editor 1.02	Corel Draw 1.01	GEM Artline 1.0	Micrografx Designer 2.0
List price	(InfoWorld weighting) \$695	\$695	\$495*	\$495	\$695
Performance	Poor	Good	Very Good	Very Good	Very Good
Speed (125)	Good	Good	Very Good	Good	Excellent
Input/output (125)	Good	Good	Very Good	Satisfactory	Very Good
Drawing/editing (200)	Excellent	Good	Excellent	Satisfactory	Very Good
Documentation (100)	Very Good	Satisfactory	Very Good	Good	Good
Ease of learning (100)	Satisfactory	Satisfactory	Good	Satisfactory	Good
Ease of use (75)	Good	Satisfactory	Good	Poor	Poor
Error handling	Satisfactory	Satisfactory	Very Good	Good	Good
Support (50)	Good	Satisfactory	Excellent	Good	Very Good
Support policies (50)	Poor	8.7	8.0	5.8	7.2
Technical support (75)	5.8				
Value					
Final score					

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EDITOR'S CHOICE

- Dell 316LT (16-MHz SX)
- Dolch P.A.C. 386-25C (25 MHz)
- IBM PS/2 Model P70 386 (20 MHz)
- Toshiba T3100SX (16-MHz SX)
- Toshiba T5200/100 (20 MHz)

Consider a 386SX portable, especially if it will be your only PC. Two of the first SX portables stand out: the Dell 316LT and the Toshiba T3100SX. They weigh about 15 pounds, have good VGA displays, and provide 2 hours of battery operation. The Dell system also does some nifty battery tricks—like

staying on for 3 minutes while you change the battery. In addition to our Editor's Choices, the Zenith SupersPort SX and AC-only NEC PowerMate Portable SX are worth considering.

Three 20-MHz and 25-MHz 386-based portables made the grade in this roundup: the Dolch P.A.C. 386-25C, the IBM PS/2 Model P70 386, and the Toshiba T5200/100. They're heavy—weighing in at 20 to 30 pounds—expensive, and worth it. They're all top performers with expandability, VGA gas plasma displays, real keyboards, and options galore.

Which one to buy? Get the 25-MHz Dolch if you want ultimate speed, the 20-MHz IBM for its 101-key keyboard (separate numeric and cursor keypads) plus its ability to use Micro Channel boards, and the 20-MHz Toshiba for its giant 9- by 6-inch screen and its ability to use classic-bus add-in cards.

We've given an honorable mention to the PC Brand 386/25 Portable III. The PC Brand is markedly cheaper than the IBM, Toshiba, or Dolch machines, but unfortunately fit and finish aren't on par with the winners. It has also yet to receive FCC Class B approval.

wherever feasible. There is only a \$600 difference between the 40MB and 104MB options.

Tipping the scales at 18.7 pounds, the T5200 will never be mistaken for an ultralight portable, but the interior real estate has been put to good use. With a base memory of 2MB, memory expansion along its 32-bit memory bus occurs in 2MB increments to a maximum of 8MB on the motherboard and 14MB with an optional daughterboard. Augmenting the main memory is a 32K high-speed static RAM cache that uses an Intel 82385 cache controller.

If number-crunching is your forte, the T5200 will accept an 80387 chip. And included on the motherboard are an IBM-compatible full-length 16-bit slot, and a dual-identity slot that will serve either as an 8-bit IBM-compatible half-length slot or a standard Toshiba expansion connector. All of this is no idle show of design fancy. Toshiba packs DOS 3.3 standard with the T5200 but will shortly offer OS/2 as an option.

Complementing its computing ability is a 640 by 480 VGA-compatible gas plasma display. While it will not extend to the full 256 shades of gray that are possible with monochromatic VGA monitors, the T5200's display is able to handle 16 gray scales admirably. Back in the office, your T5200 can snuggle up to an expansion chassis containing five IBM-compatible slots; it can also be connected to a VGA

monitor and can simultaneously support external VGA and system screen display; or, if you prefer, you can remove the plasma screen.

The 91-key keyboard has a moderately firm feel and some audible feedback from the key switches that will appeal to most users.

An odd feature, but perhaps the most welcome to the international traveller, is the T5200's power supply. Toshiba does not use a power supply with a manual switch to select input voltage ranges. Rather, the power supply auto-senses between 90 and 250 volts. You'll need an adapter for European outlet styles, but you won't need one for the voltage.

Beware, though: by the time you're done, it's more than possible to spend a fortune on the T5200. Toshiba's memory upgrade, for example, is list-priced at \$999 per 2MB expansion module, the expansion chassis at nearly \$1,200; an Ethernet card is \$700, and a 5.25-inch external floppy disk drive is a hefty \$500. Setting up the T5200 as a fully portable computer that will convert into a networking desktop machine can tax your piggy bank to the tune of almost \$13,700 at list pricing.

If that number has given you vertigo, consider your alternatives. The cost of two systems, a portable and a desktop, each with the same high-impact performance potential of just one T5200 and its accessories, makes the T5200's no-compromise environment very competitive.

ZENITH DATA SYSTEMS

Zenith SupersPort SX

by Bill O'Brien

Zenith has enough experience with computers to do things right—as it proves once again with its 16-MHz SupersPort SX. It's a sleek and trim 80386SX portable that, even with a battery pack appropriately shaped like a dumbbell clamped to its back, adds only 17 pounds of luggage to the end of your arm.

Under the cover the \$6,799 SupersPort is a marvel of miniaturization. There's room for only two 3.5-inch devices, already taken up by a Conner IDE hard disk drive and a Matsushita 1.44MB 3.5-inch floppy disk drive. Surface-mount devices pepper the slotless motherboard, and the only visible connectors are used to mount the RAM modules (to a maximum of 8MB) and attach an internal modem.

On the bottom of the case three doors open to reveal an 80387SX socket, the two ROM chips used to drive the computer, and the small battery used to hold the system setup in CMOS. Don't worry about the doors falling off while you travel; it takes a screwdriver to pry them up. The external keyboard connector is recessed along the right side of the machine and is impregnable except for its designed purpose.

Zenith's attention to the human inter-



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face—the screen and the keyboard—has produced some odd results. The display system is VGA compatible with the monochrome backlit supertwist LCD screen, which is capable of 16 shades of gray. One of PC Labs' VGA tests, however, showed only 15 distinct shades of the 16 displayed, with the center two appearing identical. It took some very fine fiddling with the brightness and contrast controls to bring out a difference between the two, and even

then it was slight.

The feel of the keyboard is excellent and appealed even to this finicky ham-fisted reviewer. Key placement may cause a problem if you've got a lazy wrist and rest your hands on the edges of the keyboard. Zenith has placed three screen-movement keys at the bottom right edge of the main keyboard matrix. These keys are so close



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Zenith SupersPort SX

Zenith Data Systems, 1000 Milwaukee Ave., Glenview, IL 60025; (800) 842-9000.

List Price: With 1MB RAM, 40MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA liquid crystal display, one parallel and one serial port, DOS 3.3, \$6,799; 3MB RAM, \$1,199.

In Short: A potent package with a not-so-palatable price; yet the SupersPort is still reasonable when compared with the other major brands.

CIRCLE 425 ON READER SERVICE CARD

to the edge that you will trigger them if you rest your right hand there.

Zenith does make one assumption about your portable habits. Once you attach the battery pack to the rear of the computer, you are cut off from the I/O ports. The company must be imagining that you will use the battery pack only when you're on the road and that—with the internal modem installed—you'd have no reason to need serial, parallel, monitor, or external disk ports. A few years ago that was a correct assumption, but as you'll find in the sidebar "Printers to Go," there are now a good crop of quality portable printers with their own batteries. They make printing on the move a reality for many newer printers, but not for the SupersPort—unless you carry your own A/C outlet.

That is the only shortcoming of the machine, and that might surprise you once you look at the benchmark test results. Perched high at the back of the 386SX portables, the SupersPort certainly doesn't appear to be a decent performer. Its Floating-Point Calculation results tell a slightly different story. This test sets up a floating-point emulation in RAM, and its results actually reflect the interaction of both the processor and conventional memory. Looking at that larger picture, the SupersPort jumps to second place among the SX machines, trailing only the Micro Express Regal II. Both its disk and video times also support its credibility.



PC Labs tests 36
286-based portables—
from lightweight
notebooks to
heavy desktop-
replacing luggables.

LAPTOPS AND PORTABLES

by Catherine D. Miller

Portables are the only format in which buying a 80286-based machine still makes sense. From battery-equipped 8-pound notebooks to AC-only 30-pound lunchboxes, 286-based portables run the gamut of portability. Processor speed, external and internal expansion options, display resolution and technology, power options, keyboards, and I/O ports vary greatly among the 36 machines reviewed in this section.

To sort through the tremendous range of features, it's helpful to break up the 286 portable market into four distinct segments: AC-powered lunchboxes, AC-mostly clamshells, battery-powered clamshells and laptops, and featherweight battery-powered laptops. Most of the machines fall into either the lunchbox category or the battery-powered clamshells and laptops category. Each segment appeals to a slightly different audience and requires different trade-offs. Several

vendors—especially such market leaders as Compaq, NEC, and Toshiba—offer 286-based portables in more than one category, with greater or lesser success in integrating the right combination of features.

AC-powered lunchboxes. To the uninitiated, comparison with a sewing machine would better describe the heft of these behemoths. The obvious trade-off for expandability and power is size and bulk. Each of the lunchbox luggables in this roundup relies on an AC power source and weighs more than 20 pounds. For example, the International Instrumentation Blue Max Attache 286, weighing more than 30 pounds, is more like a desktop machine with a handle and comes complete with a regular CRT display.

Luggables appeal to those who want a dual-purpose desktop and portable. If you plan on doing sales or product demos, look for a machine that can run an external display concurrently with its own display. You'll be able to see what's on the screen without crowding in front of the demo yourself. In this roundup, the PC Brand Portable PC III 286/12 and 286/20, Maxtron PC III 286, and the 16-MHz Data World Portacom II 286-16 all support simultaneous viewing of internal and external displays.

Typically, AC-powered lunchboxes have two standard 16-bit expansion slots. A notable exception because of its CD-ROM drive, the 10-MHz CD Technology Portable is a niche machine with only one 16-bit slot. The Micro Express Regal 286, which runs at 20 MHz, has one 8-bit and one 16-bit slot available for expansion. The lightest luggable of the bunch, the 12-MHz NEC PowerMate Portable Plus, leaves three full-length 16-bit slots open for expansion.

Only PC Brand's 12- and 20-MHz models, the Maxtron PC III 286, and the NEC PowerMate Portable Plus included VGA displays, although they weren't especially dazzling. Although the Dolch P.A.C. 286-12 and 286-16 have CGA graphics, you can choose the VGA option with the Dolch P.A.C. 386-25C (reviewed in the 386 section).

However, if you're serious about looking at luggable machines, why lug a 286 at all when you can get a 386SX, or even a 386, in the same weight and price range?

AC-mostly clamshells. The four portables we reviewed in this category tether you to an electrical outlet. These clam-

shells tend to be less expensive than their battery-operated cousins, yet sleeker and lighter than luggables. They appeal to those who need a dual-purpose office and road machine, but plan never to be far from an electrical outlet when computing en route.

Although the KISS TL-3240EL does come with a battery pack of sorts, it looks so much like three sticks of dynamite tied together that you'd never make it through airport security. The Mitsubishi MP 286L/240EVP, Toshiba T3100e/40, and the Micro Express Lyte-Byte 3400 are AC-only; of these four, only the Lyte-Byte 3400 supports internal and external displays simultaneously.

These portables have a half-length expansion slot at best. If you want expandability, look for one with an external expansion chassis so that you can fully load the system when you're using it on your desk.

Battery-powered clamshells and laptops. The machines reviewed in this category are designed to fill a variety of needs. Most weigh between 13 and 17 pounds when equipped with a battery—too heavy for all but the strongest of laps.

If you're planning to run RAM-hungry applications on the road, or if this machine will be your one and only, look for a portable that supports around 4MB of RAM. Also check to see if a coprocessor socket is available. Most have internal modem slots, and some have proprietary or standard expansion slots. The highly expandable NEC ProSpeed 286 supports 9MB and has a variety of expansion options, including an expansion chassis.

Battery life is especially important if you plan to do a lot of computing away from AC power. Lightweight battery packs and long-life batteries will be a blessing on those bicoastal and transcontinental flights. The Compaq SLT/286's batteries lasted about 3 hours under our arduous battery life tests; they weigh less than 2 pounds each. AC power modules that double as battery chargers, like those used by the NEC ProSpeed 286 and GRiD-Case 1520, are de rigeur for removable battery packs. Units like the Dauphin LapPRO-286, Sharp PC-5541, and Texas Instruments' TravelMate LT286 Model 45 use internal batteries; they accept power cords directly and don't require a transformer to charge their batteries.

The Compaq SLT/286 and the strikingly similar Veridata LapPower 286/20 boast removable keyboards, allowing you to find a more comfortable typing position. Also, many battery-equipped laptops will accept an external keyboard or numeric keypad, thereby making life a lot easier at your desk. These features make the portable a functional addition to the office, as well as a boon to those who do work while traveling between one office and another.

Displays vary from the disappointing CGA resolution of the Dauphin LapPRO-286 to the dazzling 32-shade VGA graphics of the Compaq SLT/286, Dynabook 286, GRiDCase 1520, and Veridata LapPower 286/20. Of the 16 machines we reviewed in this category, nine incorporated VGA graphics with varying success (see the sidebar "VGA Portable Displays"). There's no reason to settle for CGA when looking at machines in this group.

Featherweight battery-powered laptops. Compaq's introduction of the 7-pound LTE/286 made it clear that light weight and power need not be mutually exclusive any longer. With the LTE/286 notebook computer, Compaq has upped the ante of how much power you can expect in a lightweight laptop.

Besides the Compaq LTE/286, we review two other 12-MHz 80C286-based laptops weighing in under 10 pounds. Fully equipped with a hard disk and battery, the Bondwell B310 and Texas Instruments' TravelMate LT286 Model 12 weigh in at 8 and 6.7 pounds, respectively. Although their dimensions are slightly too large to qualify them as notebooks, either of them could slip into a roomy briefcase.

These (relative) featherweights don't sacrifice storage for lightweight totability. Each can be equipped with a 20- or 40MB hard disk, and each comes with a standard 1.44MB floppy disk drive; the TravelMate LT286 Model 12's floppy disk drive is even removable. Battery life spans 1.25 hours for the Bondwell B310 to well over 2 hours for Compaq's LTE/286.

While these machines don't offer a great deal of expandability, each supports at least 2MB of RAM. The big compromise: they only downsized CGA displays.

Light enough to put on your lap or to tote along when you're power-computing on the road, these laptops are perfect for the executive on the go who is happy with a desktop computer back at the office but doesn't want to be limited by an 8088's lack of speed and power.

ALTIMA SYSTEMS INC.

Altima One

by Lee Thé

Altima Systems wants you to replace your desktop PC with its 16-MHz 80286-based Altima One portable. And even though the new portable from the startup in Walnut Creek, California, looks like a typical clamshell-style laptop, the Altima One offers performance and features that rival most luggable and many desktop PCs—albeit 286-based ones.

Its AMD-manufactured 286 processor makes it fast; its full-sized, 101-key keyboard makes it comfortable; and an outstanding cold cathode fluorescent tube (CCFT) LCD double-scan CGA black-on-white display makes it easy on the eyes. The \$2,799 base price includes 1MB RAM (expandable to 5MB), EMS 4.0 support, a 20MB 28-millisecond hard disk, a 1.44MB 3.5-inch floppy disk drive, a 2,400-bit-per-second modem, a Logitech mouse, serial, parallel, and external video ports, and DOS 4.01. For \$3,099, you get a 40MB hard disk drive instead of the 20MB drive.

At 15 pounds and 4 by 12 by 16 inches (HWD), it's easy to move between home and office, and the built-in AC adapter aids portability because, unlike most portables, the Altima One hasn't got a clunky black

brick swinging at the end of its power cord. For the time being, this is an AC-only machine; a battery is in the works.

The display is a wonder with a quirk. In text mode, it's one of the brighter, more legible portable displays you'll find—odd, because the graphics are CGA. But the Altima One comes with a standard PC 8-bit half-card slot and offers a VGA card as an option.

Ergonomically, it's dream-time: the machine tilts up on two feet in the back to angle the keyboard. You can also slide the keyboard a few inches toward you and lock it in place or detach it completely, leaving room to prop notes between the keyboard and display. And the mouse fits in a compartment next to the display in the clamshell lid.

The CPU lives up to its 16-MHz clock speed, as our benchmark testing showed. In most respects the CPU runs a bit more than twice as fast as a standard IBM PC AT and appreciably faster than the 12-MHz 286 laptops. Both the hard disk and the display work a tad faster than an AT's—about par for a 286 portable.

Since the machine is sold direct, the one-year parts-and-labor guarantee is maintained by 16 Dow Jones service centers nationwide, with an on-site service option promised soon. It comes with a 30-day money-back guarantee.

The low pricing extends to the option list: a 5.25-inch external floppy drive is \$249, the 16-MHz 80287 math coprocessor is \$349, 1MB RAM costs \$399, and 4MB costs \$949. The VGA card is \$349 and a carrying case costs only \$49. A larger \$259 carrying case includes a clever executive briefcase/lid combination roomy enough for the \$399 Kodak Diconix 150 Plus printer option.

Lovers of true laptops need not apply, but check out the Altima One if you need a portable with a ton of features and if cost is very much a concern—and a 286 has enough computing power for you.



Altima One

Altima Systems Inc., 1390 Willow Pass Rd., #1050, Concord, CA 94520; (800) 356-9990, (415) 356-5600.

List Price: With 1MB RAM, 20MB hard disk, 1.44MB 3.5-inch floppy disk drive, CGA liquid crystal display, one parallel port, one serial port, DOS 4.01, SideKick Plus, 2,400-bps modem, mouse, carrying case, \$2,799; with 40MB hard disk, \$3,099. Optional 80287 coprocessor, \$349.
In Short: If you're looking for a desktop-replacing portable and 286 power is all you need, this economical 12-MHz 286 clamshell offers good performance, display, keyboard, and options. But if you're looking for a true laptop, look elsewhere.

CIRCLE 426 ON READER SERVICE CARD

BONDWELL INDUSTRIAL CO. INC.

Bondwell B310

by Bruce Brown

Bondwell's getting better at making laptop computers: its \$3,695 B310 is light, fast, and well-priced. The list price includes 1MB RAM, a 40MB 25-nanosecond Con-

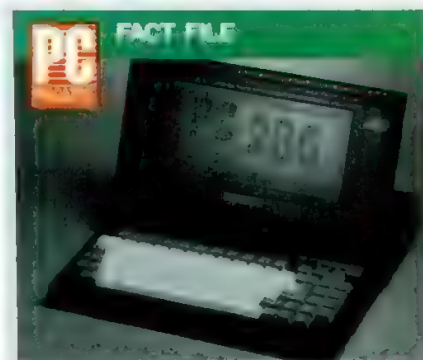
ner hard disk, 3.5-inch 1.44MB floppy disk drive, CGA LCD display, one parallel and two serial ports, DOS 3.3, and GW-BASIC.

At 2.5 by 13 by 12 inches (HWD) and 8.04 pounds, the B310 is a bit larger and heavier than most notebook-style computers. But for the extra pound and inches, you get at least that much extra performance.

The B310's 80C286 12-MHz processor, which runs at zero wait states, scored much better than average on processor- and memory-based benchmark performance tests. The Bondwell achieves its fast scores through a combination of 80ns. memory chips and special motherboard logic that optimizes the otherwise standard Intel 286 chip set.

Offsetting its fast speed is its lack of expandability. Maximum RAM is just 2MB, and there's no slot for a math coprocessor. Since there are no expansion slots, anything you want to add to the B310 has to be attached to the standard serial and parallel ports. Prices for the 1MB RAM upgrade and a 2,400-bit-per-second external Hayes-compatible modem weren't available at press time. An optional carrying case costs \$99.95.

We were most disappointed with the B310's display. Limited to 640 by 200 resolution CGA mode with only four shades of gray, the supertwist LCD display is acceptable for text applications, but the 2.28 aspect ratio flattens graphics more than



Bondwell B310

Bondwell Industrial Co. Inc., 47485 Seabridge Dr., Fremont, CA 94538; (800) 888-6331, (415) 490-4300.

List Price: With 1MB RAM, 40MB hard disk, 1.44MB floppy disk drive, CGA backlit supertwist LCD display, one parallel, two serial ports, carrying case, MS-DOS 3.3, \$3,695.
In Short: Bondwell's B310 suffers from a mediocre display and lack of expandability. Otherwise, this very fast 12-MHz 8-pound 286 laptop with standard 40MB hard disk and 1.44MB floppy disk drive comes at a competitive price.

CIRCLE 427 ON READER SERVICE CARD

competitors' screens do. There's a contrast control but no adjustment for screen brightness. While an external 9-pin port is available for an external monitor, that too is limited to CGA resolution.

The B310's clicky keyboard is a full step above those on most true notebook computers. The Bondwell has 81 keys, with ten function keys arranged across the top. There is a separate cursor-control keypad, but the numeric keypad is embedded in the normal alpha keys. The Fn key acts as a NumLock key for the keypad and has an indicator light just so you'll know it's toggled on.

In our tests the B310's 3-hour-rated battery lasted a mediocre 1 hour and 16 minutes. Extra batteries are available for \$49.95. Luckily, the AC adapter weighs less than 2 pounds and measures a mere 2 by 3.5 by 2 inches (HWD), conveniently small for traveling purposes.

Bondwell sells computers through dealers and mass merchandisers such as Sears. For service either during or after the one-year parts-and-labor warranty period you must return the computer to the dealer.

The bottom line? The Bondwell B310 is large for a notebook but light for a laptop computer. It's fast, sports an effective keyboard, and comes standard with a conventional floppy disk drive and a 40MB hard disk. But the display is behind the times, and its limited expansion may prevent you from running some of the newest programs.

Yet, at \$3,695, the B310 is competitive, especially considering its weight and performance. If you don't need graphics on the road, this might bridge the gap for you between notebook convenience and laptop power.

CD TECHNOLOGY INC. CD Technology Portable by Bruce Brown

Apart from built-in CD-ROM drive that comes standard, the 286-based CD Technology Portable is a typical AC-powered lunchbox clone. Better head to the bank first, though: the basic machine with 640K RAM, a 20MB Conner hard disk drive, 1.44MB floppy disk drive, CGA gas plasma display, one serial and one parallel port, MS-DOS 3.3, and the CD-ROM drive costs \$4,795. The unit we tested—

with 1MB RAM, a 40MB drive, and VGA gas plasma display—costs a lofty \$6,395.

Residing inside the 9.75- by 16- by 8.75-inch (HWD) lunchbox case is a 180-watt power supply, a simple I/O card with single 25-pin serial and parallel ports, a clicky 86-key keyboard, and the gas plasma display including a video card. With the three standard drives, the weight is a pound or two above the lunchbox average; our test unit weighed almost 24 pounds.

Because CD-ROM technology is inherently slow, CD Technology doesn't waste fast components on the rest of the system. Its 80286 processor is rated at just 10 MHz and can be slowed to 8 MHz. CD Technology has used the ELT motherboard and the Chips and Technologies chip set since this machine first arrived on the market in 1987—when standards for CD-ROM storage were first announced.

Also reflecting the dated design is the motherboard's maximum memory limit of 1MB; the standard 640K consists of two rows each of 100-nanosecond 256-kilobit and 64-kilobit DIP chips. If you want more RAM, CD Technology offers a different motherboard with room for 4MB. But because CD Technology views this computer as a single-purpose machine it sees no reason to provide for high memory capacity, although a single expansion slot is available in the standard configuration so that you can add a full-length 16-bit memory board if necessary.

The unit we tested had a Western Digital/Paradise 8-bit VGA card. This setup yielded but four shades of gray. If you're using text-based CDs the CGA setup should be adequate, but for stored maps or other line graphics the VGA option with finer resolution is worth the extra \$1,000.

CD Technology largely markets its machines directly, though it has two East Coast dealers. The warranty is a bit unusual, with parts-and-labor coverage on the whole system for 90 days, and coverage for only the movable parts for the first year. If you buy an optional 20-pound hard-shell carrying case for \$350, the company will cover the entire system for a year.

Most people who have purchased CD Technology's units have been salespeople who work for CD publishing companies and use the computer to demonstrate their databases to prospective purchasers or subscribers. And while this machine is heavy and slow, with no other particular



CD Technology Portable

CD Technology Inc., 780 Montague Expwy., #407, San Jose, CA 95131; (408) 432-8698

List Price: With 640K RAM, 20MB hard disk, 1.44MB 3.5-inch floppy disk drive, CD-ROM drive, CGA gas plasma display, one parallel port, one serial port, MS-DOS 3.3, \$4,795; with 640K RAM, 20MB hard disk, CD-ROM drive, VGA gas plasma display, \$5,795; with 1MB RAM, 40MB hard disk, VGA gas plasma display, \$6,395.

In Short: Purchasing this machine makes sense only if you need to take a CD-ROM drive out of the office. This 80286-based 10-MHz portable is slow and expensive, but CD Technology is the only CD-ROM game in town.

CIRCLE 428 ON READER SERVICE CARD

features to recommend it, CD Technology is the only company we know of that sells a portable with a CD-ROM drive standard.

COMPAQ CORP. Compaq LTE/286 by Mitt Jones

A year ago, talk about an 80286-based laptop computer with a 40MB hard disk drive and a 3.5-inch floppy disk drive in a package 2 inches thick might have earned you a good buy on a scale from the tail section of the Loch Ness monster. Now it simply means you've had a look at Compaq's notebook laptop offering, the 12-MHz LTE/286. Whether or not you're ready to plunk down \$4,499, you're jaded indeed if you can try it out without at least thinking of reaching for your checkbook.

Aside from the Compaq name and rock-solid construction, the allure of this machine rests primarily with its hard disk options. The base configuration gets you 640K RAM and one 3.5-inch 1.44MB internal floppy. Pay an additional \$600, and you get a 29-millisecond Conner Peripherals 20MB hard disk drive. Pay still another \$500, and you get Conner's 40MB job.

If the mass storage doesn't wow you, the EL-backlit, supertwist LCD display will. Though based only on single-scan

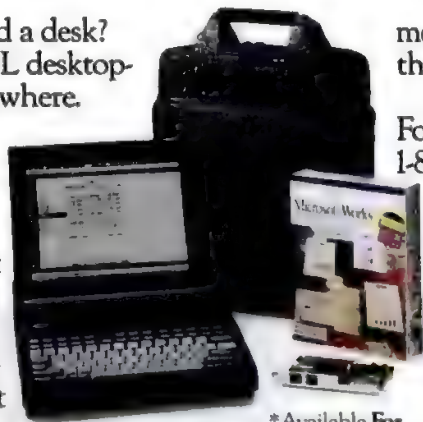


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CIRCLE 368 ON READER SERVICE CARD

PORTABLE 286-BASED

CGA (640 by 200 resolution and four shades of gray) the characters are well formed and easy to read—so much so that a conference room full of *PC Magazine* editors found themselves mistaking the display for the double-scan CGA found in most other notebook portables. The brightness and contrast controls above the keyboard allow a surprisingly wide range of usable brightness levels, and Compaq has done a nice job of minimizing the image ghosting found on most LCD displays.

Not yet impressed? Okay: thanks to a hefty, 1.5-pound battery pack and a little ingenuity on Compaq's part, the LTE/286 ran for 3 hours and 37 minutes on the PC Labs battery rundown test—even without the aid of its power-conservation utilities. With power conservation, you can expect closer to 4.5 hours. The LTE/286 manages this by shutting down the hard disk and other components after a user-definable period of inactivity. When the system itself shuts down, it issues two warning beeps and then recedes into its "standby" mode, which retains any active programs or open files. To pick up where you left off, push the standby button.

The LTE/286's battery pack slides easily into a compartment along the left panel of the machine. Compaq offers extra batteries for \$129 and an external fast charger

for \$199, a worthwhile investment if you often depend on battery power.

Other options include an internal 2,400-bit-per-second modem that fits into one of two proprietary option slots, as well as 1MB and 2MB memory expansion cards. In addition to the single parallel and serial ports along the back panel of the machine, one proprietary connector accepts an optional, external numeric keypad. Another accepts Compaq's external storage expansion module, which can house a floppy disk drive or a 40MB tape drive.

It is the layout of the keyboard that could stand improvement. The Right Arrow key is directly on the right. The Up and Down Arrow keys are stacked to the right of the Right Arrow key, making for extremely awkward cursor control. The LTE/286 comes with an alternate-function key for PgUp, PgDn, Home, and End. Insert and Delete find their homes at the back right corner of the keyboard.

The next possible drawback of the LTE/286 is its weight, though it's difficult to imagine the machine being much lighter. Our evaluation unit, with a 20MB hard disk, 80C287 coprocessor, internal modem, 2.6MB RAM, and a battery pack weighed in at 7.25 pounds. Compared with similarly equipped laptops, this machine is a featherweight. Compared to the lightest of the notebook offerings—the NEC UltraLite—7 pounds is a load.

Finally, there is the question of price: load your LTE/286 to the brim, and you'll spend \$6,000 to \$8,000. Low availability will undoubtedly keep the price close to suggested retail for quite some time.

Despite its limitations, the LTE/286 is not only the smallest full-featured laptop going, but also the only notebook laptop to boast an 80286 processor, a hard disk drive, and a socket for an 80287 math coprocessor. In that light, it's the only notebook laptop suitable for heavy DOS applications, and the only one ready for OS/2.

COMPAQ CORP.

Compaq Portable III

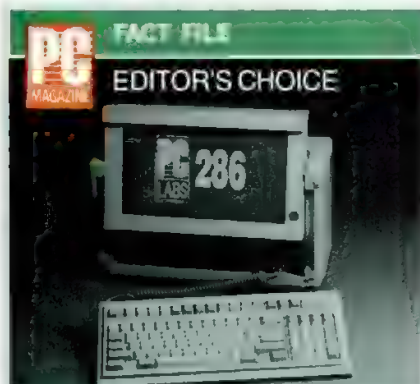
by Bill O'Brien

Somewhere between "not bad" and "all right" there's a niche that's just made for Compaq's Portable III. But life wasn't always that mediocre for Compaq's \$6,345 lunchbox, which starts at \$4,999. When

we first reviewed it back in July of 1987, editor-in-chief and publishing director Bill Machrone called it the best choice for speed on the go that could be found within 10 feet of an electrical outlet. Fifteen months later, long-time contributor Bruce Brown termed it a solid performer that was a bit pricey. Now, at the beginning of 1990, the Portable III's performance still proves to be adequate, but the engineering and technology behind it have become a bit long in the tooth.

Nothing's really changed in the Portable III. It's still an 80286 pacing the crowd at 12 MHz and packed in what's now become almost an industry-standard lunchbox enclosure. Its enclosure is, in fact, what the industry borrowed to make the standard. Compaq eschewed the idea of placing a shrunken motherboard inside the box and instead developed the Portable III as a series of interconnecting electronic modules, leaving only two proprietary slots empty. It was designed to be portable (despite its 20-pound weight) and tight, with no wiggling I/O boards that are too delicate for the day-to-day bumps and benign neglect that portables tend to experience while on the road.

If you simply must have expansion, the Portable III is no slouch. The base 640K of RAM can be bumped up to an impressive 6.6MB with the appropriate quantity of optional 1-megabit SIMMs placed on a memory board in one of the proprietary slots. The second slot accepts an internal



Compaq LTE/286

Compaq Corp., 20555 SH 249, Houston, TX 77070; (800) 231-0900 (713) 370-0670.

List Price: With 640K RAM, 1.44MB 3.5-inch floppy disk drive, CGA EL-backlit LCD display, one parallel, one serial port, utilities, \$3,899; with 1.6MB RAM, 20MB hard disk, DOS 3.31, \$5,318; with 2.6MB RAM, 2,400-bps internal modem, external storage module, external 1.2MB 5.25-inch floppy disk drive, carrying case, \$7,080.

In Short: Whether viewed as by far the most powerful notebook laptop or by far the smallest 286-based, hard-disk portable, the LTE/286 breaks new ground in DOS-to-go machines. Measures 1.9 by 11 by 8.5 inches (HWD). Drawbacks include poor placement of the cursor-control keys and a CGA-only display.

CIRCLE 604 ON READER SERVICE CARD



Compaq Portable III

Compaq Corp., 20555 SH 249, Houston, TX 77070; (800) 231-0900, (713) 370-0670.

List Price: With 640K RAM, 20MB hard disk, 1.2MB 5.25-inch floppy disk, CGA electronics and dual-mode gas plasma display, one parallel, one serial port, DOS 3.3, \$4,999; with 1MB RAM, 40MB hard disk, \$6,345.

In Short: The strongest claim for the Portable III's continued survival is its inherent quality of construction and incredible display system. Beyond that, there are faster portables available, some of which are also less expensive.

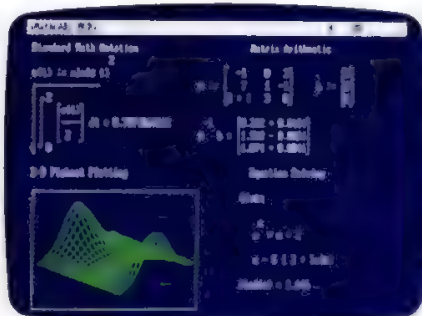
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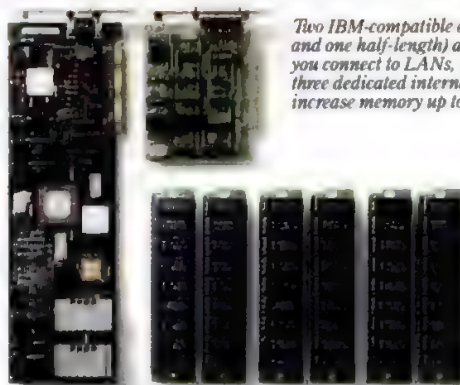
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CIRCLE 162 ON READER SERVICE CARD

VGA PORTABLE DISPLAYS: It's All in the Color Mapping

by Catherine D. Miller

Choosing a portable with a VGA display means you'll get crisper text—at 720 by 400 pixels—and sharper graphics—at 640 by 480 pixels—than from either CGA or EGA displays. But not all VGA displays are created equal. You must also consider how well it uses shades of gray to represent the 256 VGA colors of your graphics applications on its built-in monochrome display. This process is called color mapping.

Shading and mapping capabilities are built into the VGA chip set, which supplies the graphics for the portable. VGA chip sets designed for portables first became available at the end of 1988. Before then, early VGA portable pioneers, like NEC and Compaq, had to design their own VGA support from existing VGA chip sets. Most VGA chip sets designed for portables now support 16 shades of gray, with the exception of the Cirrus Logic 610/620 chip set, which supports 32 shades of gray.

Other factors contributing to the way a portable represents colors on-screen are the display technology and the way video drivers are configured. NEC, Toshiba, and Zenith all allow you to vary the way that their portables map the colors on their displays. If the graphics aren't automatically rendered properly, you can fiddle with the color-mapping until you get a more pleasing representation.

Over a third of the portables—13 286-based systems and 13 386-based machines—that we reviewed are able to display VGA-resolution text and graphics on their built-in displays. (Not included among these 26 full-VGA portables are NEC's ProSpeed 386 Laptop Computer and 16-color ProSpeed CSX Color Laptop Computer. Although their VGA chip sets allow them to output to VGA monitors, their LCD screens can accommodate text only in VGA mode; graphics are rendered at EGA resolution.)

To test the graphics mettle of these VGA portables, we put them all in the same room and ran our battery of VGA tests. We ran PC Labs Graphics Quality tests in mode 19, a 256-color VGA demo program that accompanies Rix's *ColorIX - VGA Paint* program, and a 16-color VGA demo that includes gray scaling from ZSoft Corp. We left the portables in their auto-mapping mode to see how well they did without using manual mapping procedures.

Three VGA portables—the Dynabook 286, GRiDCase 1520, and the Veridata LapPower 286/20—used the Cirrus Logic 610/620 chip set and were capable of rendering 32-shade gray scales, all with some dithering. These three did a beautiful job on all our tests, including the very arduous mandril and sphere graphics from the *ColorIX* demo. Likewise, ZSoft's gray-scale graphics were smooth and clear. These three were the stars of our VGA color-mapping tests, with the GRiDCase 1520 perhaps the most pleasing display overall.

The Mitsuba Ninja-12 VGA, as well as the Zenith SupersPort 286e and 386SX models, support 16-shade gray scales; the Compaq SLT/286 displays 8 shades of gray at VGA resolution. These four portables did surprisingly well at rendering the 256-color images, especially with the mandril and sphere tests. The graphics were not quite as smooth as those of the 32-shade portables, yet they were clear, and the portables made intelligent mapping decisions. With only 8 shades, the Compaq SLT/286 did an admirable job with the gray-scale images.

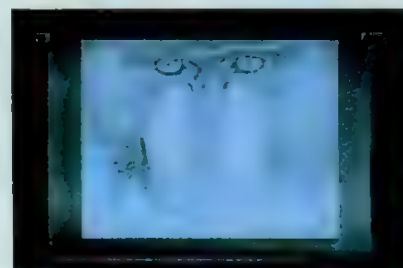
As for the other 19 VGA portables in this roundup, most of them failed to impress us with their ability to display 256-color images. Although Toshiba's T3100SX, T3200SX, T5200/100 and IBM's PS/2 Model P70 386 did fairly well on these tests, each made mapping decisions that just didn't work.

If you plan to run graphics applications on your portable, VGA is your

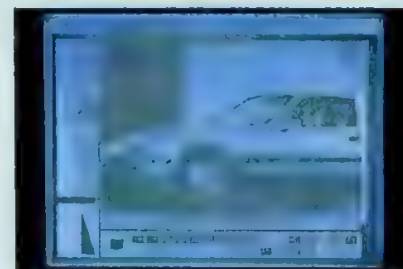
best bet. The seven portables mentioned here do a great job of rendering complicated VGA graphics without making you manually remap the shades displayed on the screen.



The GRiDCase 1520, one of three portables based on the 32-shade Cirrus Logic 610/620 chip set, renders a smoothly shaded sphere from *ColorIX*'s 256-color demo. Although the Veridata LapPower 286/20 and Dynabook 286 use different screen technologies, they map colors similarly.



With only eight shades at VGA resolution, the Compaq SLT/286 does a fine job of rendering the complicated 256-color mandril. Many other 16-shade VGA portables displayed this image as a jumble of pixels.



Both the Zenith SupersPort SX (shown) and the SupersPort 286e do a great job with gray-scale images, such as this car from the ZSoft demo. The Mitsuba Ninja-12 VGA display looks very much like this, as well.

PORTABLES 286-BASED

modem that may well be the accessory for a portable. Each card bolts into place, another piece in the puzzle.

The Portable III isn't bereft of standard IBM bus expansion opportunities, although they are somewhat limited. At the back of the machine is a connector that terminates an electronic umbilicus. For a \$199 additional charge, you can purchase an expansion box that mounts directly to this connector piggyback-style and offers two full-length expansion slots. It's the best bet for an EGA or VGA card to drive an external monitor. The Portable III's gas plasma screen is quite good even when judged by standards used two years after it was first developed. Also, you can plug in an RGB monitor, but its CGA capability is now so far removed from being relevant that anything beyond monochrome is a strain.

Standard portable stuff also abounds. Besides the monitor output, the Portable III sports both parallel and serial ports. A 1.2MB 5.25-inch floppy disk drive is part of the package, and you have a choice of 20MB or 40MB hard disks. Of course there's also the infamous Compaq keyboard, here in its guise as an 84-key model with separate keypad and ten function keys. Compaq keyboards are love/hate devices, but you can adapt to them easily even if you happen to fall into the hate category.

Of course, the test of a computer is the sum of its parts rated against the sum of the bill you pay to acquire them. Even with the last price reduction, Compaq technology is quite dear compared with the current crop of other 80286 portables or even some of the 80386 portables. Certainly the Portable III outstrips the performance of the IBM PC AT; in 1987, that was big news for a portable. Today, you should consider buying a Portable III only if you want a Compaq portable and you're not ready for its 386/20.

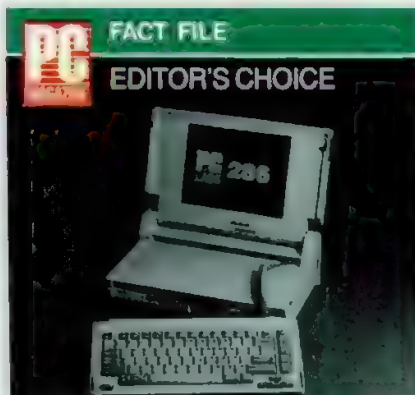
COMPAQ CORP.

Compaq SLT/286

by Robert W. Kane

When it was introduced in October of 1988, the Compaq SLT/286 was a machine well ahead of its time. Now, even with the luster off this technological gem, the \$6,118 SLT still cuts the 80286-based battery-powered mustard.

This machine has just the right mix of



Compaq SLT/286

Compaq Corp., 20555 SH 249, Houston, TX 77070; (800) 231-0900, (713) 370-0670.
List Price: With 640K RAM, 20MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA liquid crystal display, one parallel, one serial port, \$5,399; with 1.6MB RAM, DOS 3.3, \$6,218; with 640K RAM, 2,400-bps modem, \$6,118. Optional expansion base, \$999; carrying case, \$89; DOS 3.3, \$120.
In Short: Aside from its quirky keyboard layout and a shoulder-busting 16-pound package, the Compaq SLT/286 gives portable computing power, speed, and style.

CIRCLE 429 ON READER SERVICE CARD

features: 12-MHz 80C286 processor, up to 3.7MB RAM, socket for 80C287 coprocessor, backlit LCD VGA display, 1.44MB 3.5-inch floppy disk drive, and a 20MB hard disk. If you have \$600 more, opt for the unit with the 40MB hard disk. You'll get twice the disk capacity and a disk with a 1:1 interleave instead of the 3:1 interleave found on the 20MB drive.

A 16-bit interface for the VGA controller makes both text and graphics applications snap to attention on the white-on-black LCD screen. This can be reversed to black on white via the user setup program. The 1:1 interleave on the 40MB hard disk is noticeably faster than the standard 20MB disk. Unsuspecting inquisitors comment on the 386 CPU, which makes the SLT jump from task to task. Alas, if you do want to multitask, you'll have to purchase Compaq OS/2, Version 1.2 or *DESQview*. Without a 386, *Windows/386* or *DESQview 386* are not in the SLT's software repertoire.

Nonetheless, the SLT excels at keeping all this computing power going. Its rated battery life is over 3 hours; its recharge time is about 1.5 hours; and there's intelligent power management and a standby mode as well. The SLT ran for more than 3 hours on the PC Labs battery rundown test, which disengages all power manage-

ment functions to yield a worst-case battery rundown time. Unless you are running very disk- and CPU-intensive tasks, computing from coast to coast should be a breeze.

Yet, if you live with the SLT for only part of your computing day, there are certain aspects to its personality that do become annoying after a while. While the keyboard's feel is good for a Compaq and excellent for a laptop (with a bonus for being detachable), the cursor movement keys will give you *agita* the first time you try to move to the end of your word processing document. The problem is that PgUp, PgDn, Home and End are located on the separate cursor pad's inverted "T" and are accessed by holding down the Fn key and hitting the appropriate cursor key. Suddenly, elegant two-key combinations become clumsy three-key combinations.

Another price you'll pay for carrying around desktop functionality are gorilla arms. At nearly 16 pounds with its AC adapter, the SLT is no lightweight.

There is also no internal network interface support found on the SLT. The only way to hook it to a network is by putting a network adapter into the optional \$999 desktop expansion base, which can accept two full-length 16-bit ISA cards and permits connections to an external VGA color monitor, keyboard, printer, and other serial device.

These complaints aside, the SLT is a tough act to beat. Its rock-solid construction, long battery life, and demon-like speed make it a 286 overachiever.

DATA WORLD INC.

Data World

Portacomp II 286-16

by Catherine D. Miller

Data World's AC-powered Portacomp II 286-16 stands out in the luggable lunchbox market by taking a more affordable approach without sacrificing performance. Our \$3,484, 22-pound review unit was loaded with 4MB RAM, an internal Sony 1.44MB floppy disk drive, an external TEAC 1.2MB floppy disk drive, a 104MB Conner hard disk, a 10-MHz IIT-2C87 numeric coprocessor from Integrated Information Technology, DOS 3.3, and *Disk Manager* software from Ontrack Computer Systems. An EGA gas plasma screen and an external video port, as well as one

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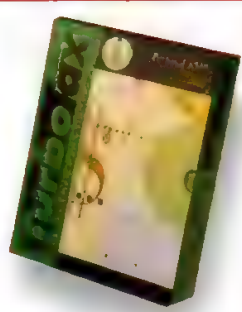
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4387	☐ Who•What•When 1.09 119.
Corel Systems ... NCP	
5506	☐ Corel Draw 1.1 329.
Crosstalk Communications ... NCP	
2908	☐ Crosstalk XVI 3.7 109.
5611	☐ Crosstalk for Windows 1.0 129.
DacEasy ... NCP	
6398	☐ Rapid Tax 1.0 45.
1748	☐ DacEasy Accounting 4.0 89.
Data Storm ... NCP	
4798	☐ PROCOMM PLUS 1.1 52.
Delrina Technology ... NCP	
4325	☐ PerFORM 2.0 169.
Delta Technology ... NCP	
5829	☐ Direct Access 4.1 52.
Digital Composition Systems ... NCP	
5876	☐ db Publisher Report Maker 2.0 . 185.
Dow Jones ... NCP	
5494	☐ News/Retrieval Membership Pkg. 24.
5th Generation ... NCP	
5504	☐ Brooklyn Bridge 3.0 79.
2762	☐ Mace Utilities 1990 89.
3950	☐ Fastback Plus 2.09 109.
FormWorx ... NCP	
5810	☐ FormWorx with Fill & File 2.5 85.
Fox Software ... NCP	
6188	☐ FoxPro 1.0 489.
2233	☐ Foxbase Plus 2.1 199.
Funk Software ... NCP	
2228	☐ Sideways 3.21 42.
4479	☐ Allways 1.0 85.
Generic Software ... NCP	
2265	☐ Generic CADD Level 3 1.13. 169.
Great American Software ... NCP	
4880	☐ One Write Plus Accounting Sys. 2.0 .179.
5825	☐ Money Matters 1.0 55.
Harvard Associates ... NCP	
2324	☐ PC Logo 3.0 59.
Hayes ... NCP	
2293	☐ Smartcom II 3.0 89.

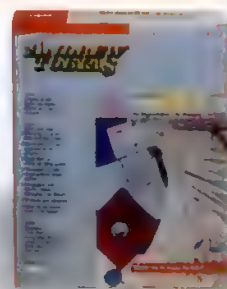


ButtonWare ... NCP
☐ **PC-File 5.0**—The most friendly, comprehensive database available. It includes letter-writing with mail merge, business graphing, and a powerful report writer. It also works directly on dBase files \$59.

burns the midnight oil.

2323	Hilgraeve ... NCP	
	HyperACCESS/5 1.0 (DOS & OS/2) \$115.	
	IBM ... NCP	
6187	Storyboard Plus 2.0	239.
	Individual Software ... NCP	
2408	Professor DOS 4.0	27.
6222	Resume Maker 1.0	29.
	Intuit ... NCP	
2426	Quicken 3.0	39.
	Lord Publishing ... NCP	
5191	Ronstadt's Financials 1.02	145.
	Lotus ... NCP	
5417	1-2-3 3.0	call
5653	1-2-3 2.2	call
5134	Magellan 1.0	149.
4131	Agenda 1.0	275.
2660	Freelance Plus 3.01	345.
	MECA ... NCP	
4603	Andrew Tobias' Tax Cut for 1989 Taxes	45.
2798	Managing Your Money 6.0	119.
	Microcom ... NCP	
2775	CarbonCopy Plus 5.1 (2 req.)	115.
	Micro Logic ... NCP	
2968	Tornado 1.8	55.
	Microlytics ... NCP	
2731	GOfar 2.0 (new version)	45.
	Microsoft ... NCP	
2860	Learning DOS 2.0	35.
2899	Windows 286 2.1	69.
2904	Works 2.0	99.
2900	Windows 386 2.1	129.
2901	Word 5.0	209.
6195	Word for Windows	329.
2856	Excel 2.1 (req. 80286/80386)	call
6133	Excel for OS/2 1.0	339.
5188	QuickPascal 1.0	69.
2894	QuickBASIC 4.5	69.
2895	QuickC 2.0	69.
2853	BC Compiler 5.1	299.
	Multisoft ... NCP	
4925	PC-Kwik Power Pak 1.5	79.
	New England Software ... NCP	
4337	GB-Stat 1.5	159.

	Nolo Press ... NCP	
2982	WillMaker 3.0	\$35.
	Norton-Lambert ... NCP	
4928	Close-Up Customer 3.0	135.
4929	Close-Up Support 3.0	165.
	Paperback Software ... NCP	
3142	VP-Planner 3D 1.0	169.
	PC Globe ... NCP	
5902	PC Globe 3.0	39.
5900	PC USA 1.0	39.
	Personics ... NCP	
3126	SeeMORE 2.0	54.
4328	Look & Link 1.1	59.
	Peter Norton ... NCP	
3152	Norton Commander 3.0	89.
3146	Advanced Utilities 4.5	89.
6397	The Norton Backup 1.0	89.
	Quarterdeck ... NCP	
3221	Expanded Memory Mgr. 386 5.0	59.
3220	DESQView 2.25	79.
4586	DESQView 386 1.0	115.
6400	Manifest 1.0	39.
6422	QRAM 1.0	49.



MECA ... NCP

Andrew Tobias' Tax Cut—Manage your taxes this year with MECA's new Tax Cut for '89. Includes expert system which lets you consult with the tax experts while you prepare your return. Editor's Choice! \$45.



Quarterdeck ... NCP

Manifest 1.0—Gives you a snapshot of your PC with detailed information about it's memory, hardware, DOS, and more. Included free with other listed Quarterdeck products through March 31, 1990 \$39.

Software Publishing ... NCP

6289	Draw Partner 1.0	59.
3499	PFS:First Publisher 2.1	89.
3478	PFS:First Choice 3.02	105.
3496	Professional Write 2.11	149.
3493	Professional File 2.01	199.
3482	Harvard Graphics 2.13	339.
	Symantec ... NCP	
5383	Budget Express 1.0	99.
3427	Q&A Write 1.01	139.
3425	Q&A 3.0	229.
3431	Timeline 3.0	399.
	Timeslips ... NCP	
2987	Timeslips III 3.4	169.
	Timeworks ... NCP	
6253	Publish-It! 1.1	115.
	TOPS ... NCP	
3724	NetPrint 2.0 (share printers)	125.
3726	TOPS Network Bundle 3.0	159.
3720	Flashcard 2.1 (AppleTalk network card; 1 year warranty)	179.



Software Publishing ... NCP

Draw Partner 1.0—Add flavor to your Harvard Graphics business presentation with Draw Partner. Zoom, Rotate, Flip, and Align are some of the advanced drawing tools available. (Requires Harvard Graphics) \$59.

Reference Software ... NCP

4396	Grammatik IV 1.0	52.
	Revolution Software ... NCP	
4480	VGA Dimmer 2.01 (screen saver)	19.
	RightSoft ... NCP	
4155	RightWriter 3.1	54.
	Samna ... NCP	
5799	Ami Professional 1.0	319.
	Softlogic Solutions ... NCP	
3546	Disk Optimizer 4.05	45.
3542	Software Carousel 3.01	55.
	Softview ... NCP	
3474	MacinTax for Windows (1989 taxes)	65.

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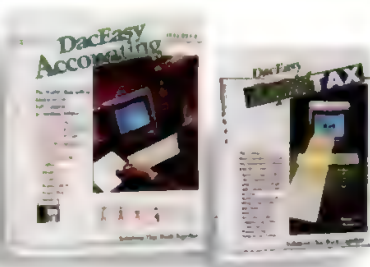
Microsoft ... NCP

Excel for OS/2 1.0—Spreadsheet which allows you to take full advantage of the power and flexibility of OS/2. Sophisticated analytical tools, easy-to-use Presentation Manager interface, and much more \$339.

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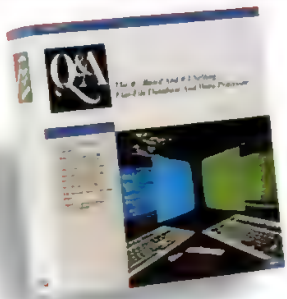
While others sleep



DacEasy ... NCP
All new versions with all new features for your business or home. Let DacEasy provide your business accounting and tax solutions.

- ☐ Accounting 4.0 \$89.
- ☐ Rapid Tax 1.0 for 1989 Taxes 45.

- Traveling Software ... NCP**
- 4190 Battery Watch 2.0 (3 1/2" only) 35.
 - 5179 ☐ LapLink III 3.0 85.
 - 3727 ☐ DeskLink 2.2 99.
- True BASIC ... NCP**
- 3561 ☐ True BASIC 2.1 52.
- Vericomp ... NCP**
- 3765 ☐ SoftBytes 2.0 35.
- WordPerfect Corp. ... NCP**
- 3799 ☐ WordPerfect Library 2.0 75.
 - 3804 ☐ WordPerfect 5.1 265.
 - 3806 Additional Network Stations 5.1 169.
- WordStar USA ... NCP**
- 2825 ☐ WordStar Prof. Release 5.5 229.
 - 5000 ☐ Upgrade to Release 5.5 89.
- Xerox ... NCP**
- 3812 ☐ Ventura Publisher 2.0 call
- XTREE ... NCP**
- 6161 ☐ XTREE Pro Gold 1.3 75.
- XYQUEST ... NCP**
- 4393 ☐ XyWrite III Plus 3.55 229.



Symantec ... NCP
☐ Q&A 3.0—The top-rated, best-selling integrated database and word processor offers simple mail merge, detailed reporting, versatile word processing, advanced network support, and more. \$229.

RECREATIONAL/EDUCATIONAL

- Broderbund ... CP**
- 1417 ☐ Where/Where? Carmen Sandiego? \$29.
 - 5701 ☐ Where/Time Carmen Sandiego? ... 32.
- Electronic Arts ... NCP**
- 5798 ☐ Ferrari Formula I 29.
 - 4659 ☐ Chessmaster 2100 (CP) 35.
 - 5804 ☐ Deluxe Paint II (Enhanced) 89.
- Microprose ... CP**
- 4454 ☐ F-19 Stealth Fighter 39.
 - 5823 ☐ Red Storm Rising 39.
- Microsoft ... NCP**
- 2858 ☐ Flight Simulator 4.0 39.
- Parlor Software ... CP**
- 3159 ☐ Bridge Parlor 2.3 49.
- Sierra On-Line ... CP**
- 6023 ☐ Leisure Suit Larry III 39.
 - 5695 ☐ Manhunter: San Francisco 33.
 - 4456 ☐ Police Quest II 39.
 - 5106 ☐ Space Quest III 36.
 - 6022 ☐ Colonel's Bequest 36.



Stone & Associates ... NCP

- ☐ 1st Math—Animated graphics teach addition, subtraction, & patterning. Ages 4-8 ... \$22.
- ☐ 2nd Math—Interactive tutorial and 7 games "teach" then "test" beginning addition through pre-calculus. Ages 7-16 \$27.

- Spectrum Holobyte ... NCP**
- 5993 ☐ Welltris (Tetris sequel) 22.
- Spinnaker ... CP**
- 5580 ☐ Sargon IV 32.
- Stone & Assoc. ... NCP**
- 3435 ☐ My Letters, Numbers, Words (2 to 6) 22.
 - 3438 ☐ 1st Math (ages 5 to 8) 22.
 - 3439 ☐ 2nd Math (ages 7 to 16) 27.
- Sublogic ... NCP**
- 6190 ☐ Air Transport Pilot 33.
- True BASIC, Inc. ... NCP**
- ☐ Kemeny/Kurtz Math Series: 10 titles each 45.

HARDWARE

Manufacturer's standard limited warranty period for items shown is listed after each company name. Some products in their line may have different warranty periods.

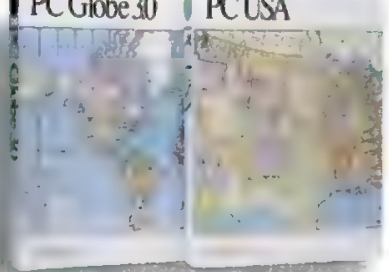


Timeworks ... NCP
☐ Publish-It! 1.1—This complete desktop publishing program includes advanced page layout, graphics, word processing, and typesetting. \$115.

- AST Research ... 2 years**
- 1299 SixPakPlus 384k C/S/P 189.
 - 4107 RAMpage Plus 286 512k. 419.
- Brother International ... 1 year**
- 5787 HL-8e Laser Printer 1899.
 - 5788 HL-8Ps PostScript Laser Printer ... call
 - 5786 Toner/Drum Kit 99.
- Central Point ... 1 year**
- 5042 Copy II PC Deluxe Option Board .. 115.
- Compucable ... 2 years**
- 1604 2-Position switch box 25.
 - 1605 3-Position switch box 35.
- Corvus ... 1 year**
- 6184 ReadyNet Starter Kit 319.
 - 6183 ReadyNet Add-On Kit 165.
- Cuesta ... 1 year**
- 1608 Datasaver 400 Watt (power backup) 429.
- Curtis ... lifetime**
- 1690 Diamond Plus SP-1+ 41.
 - 1694 Emerald SP-2 36.
 - 1707 Ruby SPF-2 (6 outlets) 55.
 - 1708 Ruby-Plus SPF-2 Plus 65.
- We carry the full line of Curtis products.
- Diconix ... 1 year**
- 5655 150 Plus Printer (Parallel) 359.
- Epson ... 1 year**
We are an authorized Epson Service Center.
- 1906 FX-850 (80 col., 264 cps, 9 pin) . . . 369.
 - 1904 FX-1050 (136 col., 264 cps, 9 pin) . 479.
 - 5183 LQ-510 (80 col., 180 cps, 24 pin) . . 349.
 - 1930 LQ-850 (80 col., 264 cps, 24 pin) . 549.
 - 4117 LQ-950 (110 col., 220 cps, 24 pin) . 569.
 - 1917 LQ-1050 (136 col., 264 cps, 24 pin) 769.
 - 4116 LQ-2550 (136 col., 333 cps, 24 pin) 989.
 - 5184 LX-810 (80 col., 180 cps, 9 pin) . . 199.
 - 1052 Printer-to-IBM cable (6 feet) 15.
- 5th Generation ... 1 year**
- 3952 Logical Connection 512k. 529.
- Hayes ... 2 years**
- 2304 Smartmodem 1200 289.
 - 2307 Smartmodem 2400 429.
 - 2308 Smartmodem 2400B (w/Smartcom II) 429.
- Hercules ... 2 years**
- 2318 Graphics Card Plus. 189.

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☐ **PC USA 1.0**—Instant profiles on all 50 states and Puerto Rico, including maps, graphics, and data \$39.
☐ **PC Globe 3.0**—Provides profiles of 177 countries. Exports to many popular programs. 39.

- Intel ... 5 years**
 4696 2400B Internal Modem 159.
 2352 2400B Internal Modem 2 (for PS/2) 249.
 5119 2400 Baud External Modem 179.
 6420 2400EX MNP Modem 229.
 2346 Inboard 386/PC w/1 Meg (w/free Ami) 579.
 2339 Inboard 386/AT (req. inst. kit) 859.
 4266 Above Board Plus 512k 419.
 4267 Above Board Plus I/O 512k 449.
 5336 Above Board Plus 8 2 Meg 699.
 5342 Above Board Plus 8 I/O 2 Meg ... 739.
 4272 Above Board 2 Plus 512k 469.
 5396 Above Board MC 320k 359.
 4275 Connection Coprocessor 579.
 4857 Visual Edge 449.
MATH COPROCESSORS
 2370 80287-8 (for 8 MHz 80286 CPU's) . 199.
 2369 80287-10 (for PS/2 Models 50 & 60) 229.
 4750 80387SX (for 80386SX CPU's) ... 309.
 2371 80387 (for 16 MHz 80386 CPU's) . 349.
 2372 80387-20 (for 20 MHz 80386 CPU's) 399.
Kensington Microware ... 1 year
 2582 Masterpiece Plus 109.
 5697 Expert Mouse (Trackball for PS/2) . 115.
Keytronic ... 3 years
 4518 101 Plus Keyboard 99.
Kraft ... 5 years
 5801 New Game Adapter (2 game ports). 27.
 5800 3 button Thunder Joystick. 29.
 5802 Trackball 69.
Logitech ... limited lifetime
 5464 Series 2 Mouse (C9 for PS/2's) ... 69.
 5151 HiREZ Mouse (C9) 85.
 6029 Trackman (Trackball) serial 85. bus 89.
 4297 ScanMan Plus (hand scanner) ... 185.
Micron Technology ... 2 years
 5818 Beyond 640 EMS Board 1 MB 369.
 5821 Beyond EX Extended Mem. Bnd. 2 MB 599.
Microsoft ... lifetime
 2897 Mouse with Paintbrush 109.
 2898 Mouse with Windows 286 2.1 139.
MicroSpeed ... 1 year
 6007 PC-TRAC Trackball serial 75. bus 85.
 6010 FastTRAP 3D Trackball serial 99. bus 109.

- Mouse Systems ... lifetime**
 5845 White Mouse (bus or serial) \$69.
 5997 Trackball (1 yr. wrnty.) serial 75. bus 85.
 4306 PC Mouse II w/PC Paint+ 89.
NEC ... 2 years
 4799 Multisync 2A (VGA Monitor) 499.
 5085 Multisync 3D Monitor 689.
Orchid Technologies ... 4 years
 4690 ProDesigner VGA (800 x 600) 249.
PC Power & Cooling Sys. ... 1 yr
REPLACEMENT POWER SUPPLIES
 3202 Turbo Cool 150 (25° - 40° cooler) 129.
 3200 Silencer 150 (84% noise reduction) 115.
Practical Peripherals ... 5 years
 3101 1200 Baud Internal Modem 69.
 3100 1200 Baud External Modem (mini) . 77.
 3103 2400 Baud Internal Modem 139.
 3102 2400 Baud External Modem 179.
 5286 2400 Baud Int. MNP Modem (Lex. 5) 175.
 5285 2400 Baud Ext. MNP Modem (Lex. 5) 209.
 4542 2400 Baud Internal Modem for PS/2. 229.

2400EX Modem



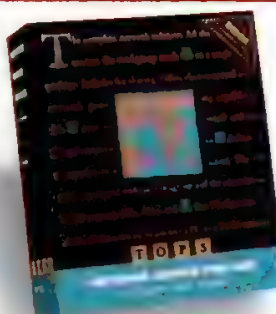
Intel ... 5 years
 2400EX MNP Modem—MNP support allows error-free transmission as well as data compression providing 2400 bps throughput up to 4800 bps. Also supports Hayes compatible operation \$229.

- Safe Power Systems ... 2 years**
 4561 Safe 250W (standby power bkup) 249.
 4562 Safe 425W (standby power bkup) 369.
SOTA Technology ... 2 years
 5107 Floppy Drive Controller (SS/p) 99.
 5111 SOTA 286i-12 (12 MHz accelerator) 269.
 5402 SOTA 386i-16 (16 MHz accelerator) 389.
Targus ... lifetime
 4899 Nylon Laptop carrying case 55.
 6037 Premier leather carrying case 199.
TheComplete PC ... 2 years
 5598 TheComplete Half Pg. Scanner 400 189.
 4887 TheComplete FAX 9600 429.
 5140 TheComplete Page Scanner 549.
 5828 TheComplete Communicator 559.

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TOPS ... NCP
Network Bundle for DOS 3.0—Allows you to quickly and easily share files, electronic mail and printers between your Apple Macintosh, IBM PC and/or Sun Workstation. Now includes Inbox EMail software \$159.



- Toshiba ... 1 year**
 3684 T1000 Laptop (80C88, 6.4 lbs.) ... 669.
 4958 T1600 Laptop (12 MHz, 20 Meg) . 3249.
Tripp Lite ... 2 years
 6201 Isobar 8 (8 outlets, 12 ft. cord) 69.
 6019 LS 600 Line Stabilizer 85.
 6018 LC 1200 Line Conditioner 159.
Video 7 ... 7 years
 5883 1024i VGA (includes 512k) 289.
 4931 VRAM VGA 512k 449.

DRIVES

- DTC ... 1 year**
 6248 AT Floppy/Hard Drive Controller . 129.
IOmega ... 1 year
 5116 Bernoulli II Single 44 Meg Internal 995.
 5117 Bernoulli II Dual 44 Meg External 1969.
 5113 44 Meg Cartridge Tripak (5 1/4") ... 249.
 2499 PC2 Card (controller required) ... 169.
 2500 PC2B Card (bootable card) 229.

Microlytics ... NCP
☐ **GO for 2.0**—The original, affordable, simple, painless, quick, easy, and fast text-retrieval software package for IBM PC and compatible computers \$45.



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*DEFECTIVE SOFTWARE REPLACED IMMEDIATELY. DEFECTIVE HARDWARE REPLACED OR REPAIRED AT OUR DISCRETION.

Order line open 'til 1 AM.

Mountain Computer ... 1 year

2917	40-60 Meg Internal Tape Drive...	\$379.
2935	40-60 Meg Int. Tape Drive for PS/2	379.
5502	83-152M Ext. Tape Drive	759.
5500	83-152M Int. Tape Drive	629.
6153	DC2120 Cartridge (5 pack)	135.
5190	DC2000 Pre-formatted Cartridges ea.	35.

Pacific Rim ... 1 year

5010	1.2 Meg External	215.
5011	360k External 5 1/4" Drive	179.

Plus Development ... 2 years

3105	Hardcard 20 Meg (49 ms)	529.
3106	Hardcard 40 Meg (28 ms)	599.
6424	Hardcard II 80 Meg (19 ms)	699.

Seagate ... 1 year

FREE PCTV® Hard Drive Installation
Tape with purchase of 20, 30 or 40 Meg
Seagate drive for the IBM PC (not for
AT). Beta or VHS.

2285	20 Meg Internal Hard Drive ST225 (w/controller and cables, 65 ms)	289.
2286	30 Meg Internal Hard Drive ST238 (w/controller and cables, 65 ms)	299.
4554	40 Meg Int. HD ST251-1 (28 ms)	359.
2287	40 Meg Int. HD for PC ST251-1 (w/controller and cables, 28 ms)	429.
4624	80 Meg Int. HD ST4096 (28 ms)	619.

DISKS

All disks have a lifetime warranty.

5 1/4" DS/DD Disks (360k)

3291	Sony (10 disks per box)	\$12.
2789	Maxell MD2-D (10 disks per box)	13.
4192	Verbatim Datalife (10 disks per box)	13.

5 1/4" DS/HD Disks (1.2 Meg)

3770	Verbatim Datalife (10 disks per box)	19.
3292	Sony (10 disks per box)	19.



Intel ... 5 years Samna ... NCP
Inboard 386/PC with Free Samna Ami—The
Inboard 386/PC gives you 80386 processing
power, and a free Samna Ami Windows-
based word processor (regularly at \$129).
Offer good through March 31, 1990. \$579.

MEMORY

3248	256k DRAMs (120 nanosecond)	call
4366	1 Meg x 9 SIMMs (100 nanosecond)	call
5510	1 Meg x 9 SIMMs (80 nanosecond)	call
5746	1 Meg Chips (80 nanosecond)	call

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- We accept VISA and MASTERCARD only.
- No surcharge added for credit card orders.
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- If we must ship a partial order, we never charge freight on the shipment(s) that complete the order (in the U.S.).
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- APO/FPO orders shipped 1st Class Mail.
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- To order, call us Monday through Friday 9:00 AM to 1:00 AM, or Saturday 9:00 AM to 5:30 PM. You can call our business offices at 603/446-3383 Monday through Friday 9:00 AM to 5:30 PM.



XTREE ... NCP

☐ **XTREE Pro Gold 1.3**—A treasure of advanced disk management features—Directory Tree Display, Application Menus, Archive Management, Autoview & Enhanced View. Single keystroke commands for all operations. \$75.



Peter Norton ... NCP

☐ **The Norton Backup 1.0**—Save your data before you lose it with the all new Norton Backup. 3 user modes for ease of operation at any level plus many more advanced features make your backups easy. \$89.

TEAC ... 1 year

4950	PC, XT 360k Drive (5 1/4")	79.
4951	720k Drive (specify XT or AT, 3 1/2")	79.
4670	1.44 Meg Drive for XT (3 1/2")	99.
4326	1.44 Meg Drive for AT (includes Basteck software utilities, 3 1/2" copy prot.)	119.

MISCELLANEOUS

Checkfree

6360	CheckFree Xpress	25.
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CompuServe

1676	CompuServe Information Service	24.
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Cables ... lifetime

1019	Smartmodem-to-AT cable (10 feet)	15.
5511	Right Angle Printer cable (6 feet)	15.
1050	Parallel Printer cable (15 feet)	19.

Practical Peripherals ... 5 years

2400SA MNP—Fully supports error-free MNP Level 5 data transmission, giving you more confidence in your communications. Also supports Hayes compatible 2400 bps standard operation. \$209.

2790	Maxell MD2-HD (10 disks per box)	19.
	3 1/2" DS/DD Diskettes (720k)	
3297	Sony (10 disks per box)	14.
3772	Verbatim (10 disks per box)	15.
2792	Maxell (10 disks per box)	15.
	3 1/2" DS/HD Diskettes (1.44 Meg)	
3298	Sony (10 disks per box)	29.
3773	Verbatim (10 disks per box)	29.
2793	Maxell (10 disks per box)	29.

SHIPPING

Note: Accounts on net terms pay actual shipping.

Continental US:

- For monitors, printers, Bernoulli Boxes, computers, hard drives, and power backups, pay actual charges. Call for UPS 2nd-Day & Next-Day-Air.
- For all other items, add \$3 per order to cover UPS Shipping. For such items, we automatically use UPS 2nd-Day-Air at no extra charge if you are more than 2 days from us by UPS ground.

Hawaii:

- For monitors, printers, Bernoulli Boxes, computers, hard drives, and power backups, actual UPS Blue charge will be added. For all other items, add \$3 per order.

Alaska and outside Continental US:

- Call 603/446-3383 for information.





PC Celebration.

Furrier & Jive.

(Or, welcome back to the gay nineties.)

People are always asking if the celebrated rural outpost of Marlow, NH (pop. 561, Car. Rt. Sort 03456), is really ready for the '90s. Ready???? Why, if you give us a few minutes to hitch up the horses, light the oil lamps, pop open the parasols, and set a few bonfires, we'll make Currier and Ives look like Bert and Ernie. You see, even though our picture postcard town now has more printers than people, we still know the traditional way to ring out the old and ring in the new.

Oh sure, we've heard the talk about how technology is going to

change everything. But, no matter how many megahertz you muscle into your micro, or how much resolution you ram into your rasters, or how many points per inch you output to print, you can still rely on us to deliver an irresistible combination of down-home prices and up-country personal service.

Better keep our sox on.

It's important that we all keep our tootsies toasty as we stroll down the old stage road into the last decade of the 20th Century. So we're giving a free pair of genuine 100% wool PC Connection Sox to everyone who places an order of \$500 or more between now and March 31.



Enjoy safe sox all winter long with warm and toasty 100% wool PC Connection Sox. Offer not available to accounts on net terms. One per customer.

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parallel and two serial ports, are standard fare. Since Data World sells direct, you can expect to pay the quoted prices.

Data World packs standard AT components into the ubiquitous 9.5- by 15.5- by 8-inch (HWD) Chicony lunchbox case. The Genesis 1612 motherboard from Synaptix is centered around a 16-MHz NMOS 80286 processor from AMD, with a Zymos chip set offering supporting functions. The AMI 286 BIOS offers video and system BIOS shadowing, both of which can be disabled. Four SIMM banks accommodate a total 4MB of 80-nanosecond RAM using 1-megabit chips. The numeric coprocessor socket supports coprocessors rated from 8 to 16 MHz.

Two banks of rocker switches, SW1 and SW3, and two rotary switches, SW2 and SW4, are located on the motherboard. SW3 lets you choose among zero, one-quarter, one-half, and one wait states, concurrently setting the expansion bus speed to 8 or 10.6 MHz. SW1 must be set to indicate the amount of memory installed in the system. Bank SW2 switches enable or disable the disks, I/O ports, and color monitor support. Bank SW4 switches further fine-tune the way that the system's SlyPHASE memory configuration is set.

One 25-pin parallel and two serial ports—a 9-pin and a 25-pin—are built

PORTABLES 166-BASED

onto the motherboard along with a floppy disk drive controller and support for an IDE hard disk drive. Our evaluation unit included a 27-millisecond 104MB Conner hard disk drive. The IDE controller for this RLL drive has a 1:1 interleave and includes a 32K look-ahead buffer to further increase disk performance.

Of the four 16-bit and two 8-bit expansion slots, only two 16-bit slots were available in a fully configured system. One 16-bit and one 8-bit slot were obstructed by the 150-watt Flow Max power supply. The other 8-bit slot was used for an I/O port connector, and a 16-bit slot was occupied by the Chicony EGA card based on the Gemini VC-001 controller chip. The video card includes a 9-pin digital monitor and RGB port.

A gas plasma display with a maximum resolution of 640 by 350 supports EGA, CGA and MDA video modes. The 5.5- by 8.25-inch (HW) screen can be tilted to about a 105-degree angle. Because it is capable of displaying only four shades of color and suffers from a 1.62 aspect ratio, its graphics are indistinct. Simultaneous support of internal and external displays increases the system's attractiveness.

The Portacom II 286-16 was a top performer among 286 portables in all but the video performance tests, where its scores were in the lower half of the pack. A turbo key allows you to switch the processor speed from 8 MHz to 16 MHz without changing motherboard switches.

The detachable 102-key Chicony keyboard is laid out conventionally, but its 12 function keys are arrayed in a double row above number keys 2 through 7. Also, the Backslash key is located too far to the right, making directory changes awkward.

Just about all you need to set up and upgrade this system can be found in reference manuals included with the system. A carrying case is also standard fare.

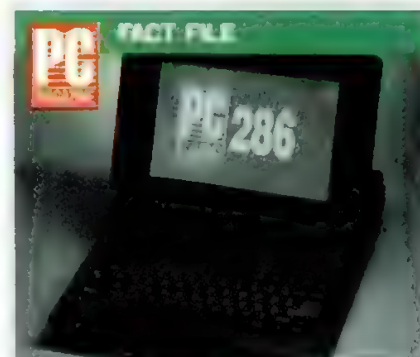
If you're in the market for a fast and powerful 286 luggable, Data World's Portacom II 286-16 is a great deal.

DAUPHIN TECHNOLOGY INC.

Dauphin LapPRO-286

by Jennifer Zaino

Coming from a company called Dauphin Technologies, I expected the LapPRO-286 to be one prince of a portable. And



Dauphin LapPRO-286

Dauphin Technology Inc., 1125 E. St. Charles Rd., Lombard, IL 60148; (312) 627-4004.

List Price: With 1MB RAM, 20MB hard disk, one 1.44 3.5-inch floppy disk drive, CGA/Hercules display, AlphaWorks and LapLink software, DR-DOS 3.4, \$3,195; with 1MB RAM, 40MB hard disk, external 360K 5.25-inch floppy disk drive, \$3,754; with 2MB RAM, 40MB hard disk, \$3,820. **In Short:** Odd keyboard layout, weak display characteristics, and a princely price make the Dauphin a laptop to avoid.

CIRCLE 543 ON READER SERVICE CARD



Data World Portacom II 286-16

Data World Inc., 3733 San Gabriel River Pkwy., Pico Rivera, CA 90660; (800) 722-7702, (213) 695-3777.

List Price: With 512K RAM, 20MB hard disk, one 1.44MB 3.5-inch floppy disk drive, external 1.2MB 5.25-inch floppy disk drive, EGA gas plasma display, one parallel port, two serial ports, carrying case, \$2,460; with 1MB RAM, DOS 3.3, \$2,630; with 4MB RAM, 104MB hard disk, \$3,319; with 10-MHz numeric coprocessor, \$3,484.

In Short: The Portacom II 286-16's standout feature is its ability to operate an external monitor simultaneously, making it especially useful for sales demos on the road. If you're looking for 286 value in a luggable portable, this unit offers solid performance at a great price.

CIRCLE 542 ON READER SERVICE CARD

certainly it has its good points, among them a screen legible from a wide angle and a sturdy black plastic casing capable of protecting the innards from the hazards of on-the-road travel. But it just doesn't have what it takes to play the Palace.

For \$3,195, the 12-MHz LapPRO-286 comes with 1MB of RAM, a 40MB hard disk, an LCD display, and an internal 1.44MB floppy disk drive. An additional \$559 will buy you the system we reviewed, which oddly enough included an external 360K floppy disk drive rather than the company's 1.2MB model. The clamshell design features a built-in handle, and a soft carrying bag is also available. The unit ships with Digital Research's DR-DOS, the integrated program AlphaWorks, and LapLink. Dauphin offers a fair range of options: the motherboard accepts up to 4MB of RAM, a single-slot expansion chassis can accommodate an add-in board, and the company offers an external 1,200-bit-per-second modem, as well as internal 2,400-bps and 4,800-bps models.

While LapPRO lagged behind the competition on our video and hard disk benchmark tests, it made up some ground with its front-running scores on our Instruction Mix, Floating-Point Calculation, and Conventional Memory tests.

Even so, this machine lacks the finesse of others in its class. Its backlit, double-scan CGA and Hercules monographics display must be commended for holding an image even when viewed from a fairly

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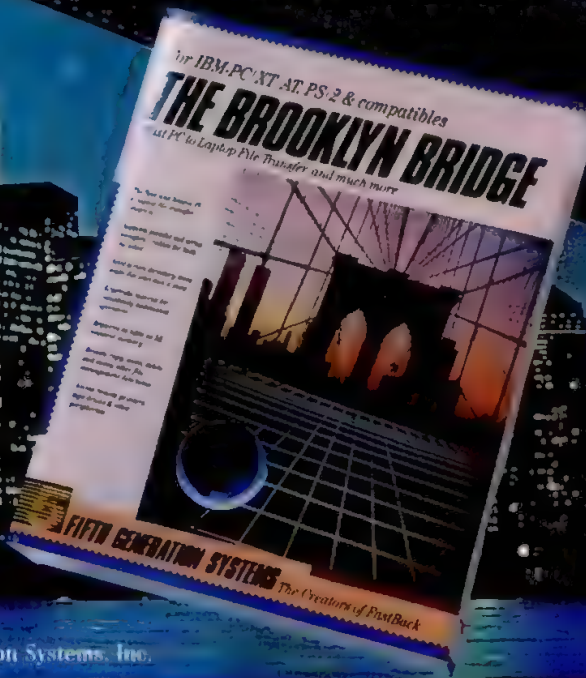
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The Brooklyn Bridge does everything that popular "PC-to-Laptop" programs do, only faster and easier. But it does so *much more* that it's in a category all by itself. No wonder PC Magazine named it *Editor's Choice* this year, for the second time.

And that's why I'm sure *you'll* buy **The Brooklyn Bridge**. Because it's the best, most complete file transfer program there is. Period.



Barry L. Bellue
President and C.E.O. of Fifth Generation Systems, Inc.

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(Corel Systems)

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(Dac Software)

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(FormWorx Corp.)

Process your paperwork quickly with a program that allows you to create and fill out forms in your PC rather than by hand. Fill out professional forms tailored to your specific needs then sort the data for future use. **\$83.**

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(Datastorm Tech)

Procomm Plus is the definitive communications program. It boasts an extremely powerful script command language, context-sensitive help, 16 terminal emulations and keyboard remapping. In addition it offers 12 file transfer protocols, a fully automated dialing directory and advanced host mode with electronic mail. **\$50.**

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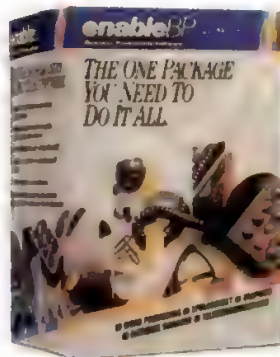
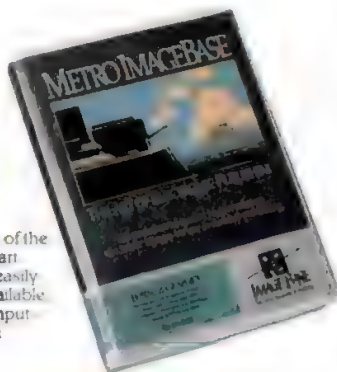
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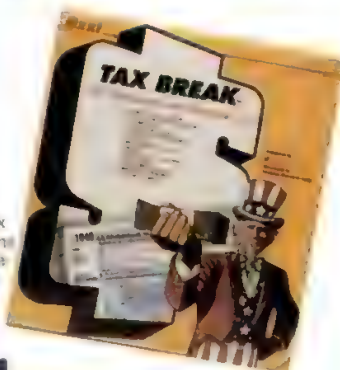
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Teacher in a Box-WordPrft 5.0	62.
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Teacher in a Box-Lotus 3.0 L.1	62.
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CAD SOFTWARE

American Small Business Co.

Design CAD 3D 2.1	205.
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Drafix

Windows CAD	429.
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Generic Software

Basic Home Design	31.
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Generic CAD 3D Drafting	129.
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Generic CAD Level 3 w/ Dot Plot	159.
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MathSoft

MathCAD 2.5	285.
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generous peripheral distance, but its low resolution can't compete with the VGA displays now available on many similar portables. The display loses legibility with the backlighting turned off. If you want to steer clear of ghosting or image fading, choosing your brightness setting becomes an all-or-nothing proposition.

At 16.73 pounds with the battery pack, you won't want to keep the LapPRO-286 on your lap for too long. The battery has a rated life of about 90 minutes, although it logged almost 2 hours on our battery run-down test. The unit accepts a regular power cord for recharging.

The 75-key keyboard incorporates a separate numeric keypad with its own Home, End, PgUp, and PgDn keys. Unfortunately, it is positioned directly below the 3.5-inch floppy disk drive; inserting a disk so as not to disturb the keypad keys requires a gentle agility. The machine also lacks dedicated function keys; F1 through F12 are overlaid with the number keys. Other flaws include placement of the arrow keys (on the numeric keypad, where you have to stre-e-e-tch across the wide expanse of the main keyboard to reach them), as well as the Esc and Backspace keys (which are right next to each other).

The unit we reviewed featured ports clearly labeled as COM1 and COM2. While the external drive we plugged into the 25-pin COM1 functioned—erratically—we were unable to get a modem to operate via this port. System snooping with *The Norton Utilities* revealed that the machine recognized only one serial port. Dauphin explained that the port labeled COM1 is actually an external floppy jack. Users can order a second serial port in its place or upgrade later.

The LapPRO-286 disappoints in the two most important features of portables: screen and keyboard. Its price is no bargain either. In a market glutted with 286-based battery-powered portables, you can certainly do better.

DOLCH COMPUTER SYSTEMS
Dolch P.A.C. 286-12
Dolch P.A.C. 286-16
by Catherine D. Miller

A yellow-on-gray electroluminescent screen surrounded by a stylish dark gray case sets the Dolch P.A.C. 286-12 and P.A.C. 286-16 apart from the 286 lunch-

box crowd. And although they're rather pricey, reasonable performance and an external expansion chassis make these systems worth considering if you're looking for a luggable that will double as a desktop computer.

DOLCH P.A.C. 286-12

In addition to the 1MB RAM, 1.2MB floppy disk drive, 40MB hard disk, CGA electroluminescent screen, one parallel and one serial port, DOS 3.3, and the 86-key keyboard that come standard with the \$4,145 P.A.C. 286-12, our \$4,640 evaluation unit included an Intel 10-MHz 80287 numeric coprocessor and an additional serial port.

At the heart of the 21-pound P.A.C. 286-12 is the Monolithic Systems motherboard, masterminded by a Harris 12-MHz 80286 and supporting G2 chip set. The G2 chip set was surface-mounted, allowing for a cleanly designed system board with few discrete chips.

A maximum of 4MB of DIP-style DRAM memory can be installed on the motherboard. Our P.A.C. 286-12 evaluation unit came with 1MB of 80-nanosecond DRAM consisting of 256-kilobit chips. DIP switches on the motherboard let you operate the system at zero or one wait state and cut the 12-MHz processor and I/O bus speeds in half.

The AMI 286 BIOS offers both video and system BIOS shadowing. Both can be turned off if they interfere with your software's performance. Ctrl-key combinations let you switch between clock speeds of 6 and 12 MHz and between zero and one wait state.

Of the one 8-bit and seven 16-bit expansion slots, only six 16-bit slots are usable; three will accommodate half-length cards only. A fully configured system leaves two 16-bit slots for add-in cards: four slots were occupied by video, disk controller, Everex's I/O port card, and an additional serial port.

The detachable 86-key keyboard included with the 9.5- by 15.75- by 8-inch (HWD) case was laid out in the old AT style, except that the 12 function keys are at the top of the keyboard instead of down the left side.

To adjust the electroluminescent CGA screen to a comfortable angle, you simply push a small panel located at the right of the screen. For CGA, the screen was very readable, although the yellow background

is much brighter than a gas plasma display's amber, making it potentially tiresome to the eyes during extended use. Indeed, a VGA gas plasma display is now available for \$595. You can switch the standard display to reverse video, as well. The P.A.C. 286-12 did a good job of displaying all CGA modes in our graphics compatibility tests, representing colors with four brightness levels. The aspect ratio tested out at 1.54, which is fairly typical of portables.

Dolch manufactures its own 8-bit video card using the Yamaha video controller chip. The card includes a 9-pin digital port for an external monitor, but internal and external displays cannot be operated simultaneously.

We weren't confronted by a jumble of cables when we opened the P.A.C.'s case because the two half-height drive bays, accommodating either 5.25- or 3.5-inch devices, were occupied by 3.5-inch devices. Toshiba's 25-millisecond 45MB MFM



Dolch Computer Systems, 2029 O'Toole Ave., San Jose, CA 95131; (800) 538-7506, (800) 223-2077 (in Calif.), (408) 435-1881.

Dolch P.A.C. 286-12

List Price: With 1MB RAM, 40MB hard disk, one 1.2MB 5.25-inch floppy disk drive, CGA electroluminescent display, one parallel and one serial port, \$3,995; with DOS 3.3, \$4,145; with a 10-MHz 80287 coprocessor and an additional numeric serial port, \$4,640.

CIRCLE 603 ON READER SERVICE CARD

Dolch P.A.C. 286-16

List Price: With 1MB RAM, 40MB hard disk, one 1.2MB 5.25-inch floppy disk drive, CGA electroluminescent display, one parallel and one serial port, \$4,995; with DOS 3.3, \$5,145; with 2MB RAM, 10-MHz 80287 coprocessor, \$6,030; with 2,400-bps modem, \$5,730.

In Short: Both the P.A.C. 286-12 and the P.A.C. 286-16 are well-designed luggables offering reasonable performance and ample expansion capabilities, making them good alternatives for a combination office and road warrior. But these capabilities don't come cheap, making the Dolch duo less desirable than other options.

CIRCLE 644 ON READER SERVICE CARD

hard disk was controlled by National Computer's integrated controller card. This card is capable of handling two floppy disk drives and two hard drives. If you're looking for a luggable that comes standard with a 5.25-inch drive, the P.A.C. 286-12 includes Toshiba's 1.2MB floppy disk drive.

DOLCH P.A.C. 286-16

Motherboard circuitry, processor, and memory chips are the only differences between the P.A.C. 286-12 and the P.A.C. 286-16. The P.A.C. 286-16 also uses a motherboard from Monolithic Systems. DIP switches on the motherboard provide the same functions, and a maximum of 4MB DRAM is arranged in the same fashion as described for the P.A.C. 286-12. However, our \$6,030 P.A.C. 286-16 evaluation unit included 2MB of DIP-style DRAM consisting of 70-ns. 1-megabit chips, and its expansion bus runs at either 8 or 16 MHz.

Although the standard-configuration P.A.C. 286-16 is similar to the P.A.C. 286-12, it carries a list price of \$5,145, a full \$1,000 more for the additional speed of the 16-MHz processor.

Both units' performances on our processor and memory benchmark tests were significantly above average for their respective classes of portable. But because each unit uses an 8-bit CGA card and MFM drive, it wasn't surprising that video and disk performance times for these units were among the slowest.

Overall, the Dolch P.A.C. 286-12 and P.A.C. 286-16 are well-designed lunch-box systems offering both reasonable performance and ample expandability, but neither machine is inexpensive. However, these machines are worth considering if you're looking for a luggable for use at the office and on the road.

DYNABOOK TECHNOLOGIES CORP.

Dynabook 286

by Bruce Brown

It's fast, classy, and easily misunderstood. The Dynabook 286 goes beyond normal laptop computers by offering an impressive array of components to mix and match as your needs demand. In one scenario all you need carry is a 6.5-pound core module with CPU, keyboard, drives, memory, and I/O ports, but no monitor. If you want

PALMTOPS: Tiny Containers For All Your Desktop Data

by John Dickinson and Jonathan Matzkin

Some of the hottest-selling small computers on the market today are too small to fit on your lap and cannot run DOS. Instead, these sublaptop-sized computers fit into your pocket or purse and connect to your PC and any networks the PC is hooked into. You're more likely to find these machines on sale at Macy's rather than at Computerland.

These five palmtops—the Atari Portfolio, the Casio B.O.S.S., the Psion Organizer, the Sharp Wizard, and the Tandy WP-2—don't pretend to be substitutes for your laptop PC. They're supplements that allow you to move your personal affairs and planning into the electronic age. They offer productivity and connectivity by replacing calendars, diaries, address books, and Rolodexes; and you can keep both the desktop and palmtop versions of these *databases* identical by downloading files with optional software and cabling.

Watch for products in the next year that will let you keep your pocket computer's calendar and address file in sync with a networked, groupware-style calendar. That's going to be important as both sublaptops and networked calendaring become important executive productivity tools.

Atari Portfolio (800-443-8020) Compared to the other sublaptops, the Portfolio is huge. At 1.12 by 7.75 by 4 inches (HWD), it just makes it into your vest pocket. The Portfolio not only looks like a little laptop PC, it acts like one—with a full QWERTY keyboard you can type on (but not touch type) and a 40-character by 8-line screen that is probably the most legible LCD screen we've ever seen.

The Portfolio runs a DOS clone called the DIP Operating System. The clone includes most of the familiar DOS commands; it treats the Portfolio's internal memory as a 32K hard disk and the battery-backed removable RAM cards as 123K floppy disks.

The Portfolio comes with an address

book, calendar, calculator, editor, and spreadsheet, all of which look suspiciously familiar—its .WKS files, for instance, are Lotus 1-2-3-compatible. And the editor looks like any number of utility editors favored by programmers. Given the relatively good size and shape of the Portfolio's QWERTY keyboard, you might consider using it for writing or note taking. The applications can use Atari-supplied software and a \$49.95 optional parallel port to link to your PC and transmit data in either direction.

The base memory configuration of the Portfolio includes 128K of program memory. A 32K internal RAMdisk can be treated as a permanent hard disk. The floppy-disk-like RAM cards cost \$79.95 for a 32K model, \$129.95 for 64K, or \$199.95 for a 128K model. Atari has announced the Memory Expander Plus, a 256K internal RAM card that can be split between disk space. You can stick with the Atari-supplied programs or download programs from your PC. Be aware, however, that if your program exceeds 128K or accesses hardware directly, it probably won't run on the Portfolio. Communications programs have proven especially difficult—although a specially patched version of the Kermit terminal program ran quite well. Atari plans to introduce communications software in the near future that should allow you to log on to MCI mail or to your internal electronic mail system.

Casio B.O.S.S. (800-634-1895) The B.O.S.S. comes with a 6-line by 32-character LCD screen, a full set of programs, and what may be the world's smallest QWERTY keyboard. When you open the tiny SF-7000, it looks like the world's tiniest laptop PC.

Casio has developed a B.O.S.S. lineup that includes two physical sizes: the SF-7000/7500, which measures .25 by 2 by .87 inches (HWD) and fits into your shirt pocket; and the larger SF-

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to take along a display but will use only AC power, the ante is upped a bit to 9 pounds; 11 pounds if you take the AC adaptor too. For work away from outlets, add the optional 5.5-pound flat battery. Lots of laptop vendors talk about flexibility and modularity; Dynabook has just done it better.

As usual, quality doesn't come cheaply. The base unit Dynabook with 1MB RAM, 20MB hard disk, 1.44MB floppy disk drive, transmissive LCD VGA screen, two serial and one parallel port, DOS 4.01, SmartStart setup, utility, and on-line documentation software lists for \$5,195. Our test unit with 2MB RAM, a 43MB hard disk drive, 2,400-bit-per-second modem, and battery topped out at \$7,133.

If you attach the bottom-slice-style battery and leave the screen on, the Dynabook is 2.4 by 13.6 by 11 inches (HWD). Without the battery, the thickness decreases to 1.73 inches. The case is made of sharp-looking black magnesium. Attaching and detaching the various components is so easy that you can do it with your eyes closed once you know how.

The Dynabook 286 uses low-compromise components that meet most users' performance needs. The 16-MHz 286 processor brings the unit near the top of the heap of the 286 benchmark scores, leaving several 386/16s and SXs behind as well. However, you're limited to a maximum of 4MB RAM, which some might find constraining.

The VGA display is almost excellent. The aspect ratio is right on at 1.33, producing nice round circles for true graphics. The display can produce up to 32 shades of gray. The screen is a good size, 11 inches in diagonal, or 8.8 inches wide by 6.6 inches high. The only complaint I have about the display is that I had to fiddle with the brightness and contrast controls more often than with most other high-end LCD screens. If you don't use the attached display there's a 15-pin port for an external monitor.

The Dynabook's full-sized 85-key keyboard has 12 function keys across the top, separate cursor and page-movement keys, and an embedded numeric keypad. There are separate ports for an external PS/2-compatible keyboard and mouse. You can use the parallel port for an external floppy disk drive, using the Toshiba standard for this facility.

In addition to the normal I/O ports, keyboard and mouse ports, and the video port,

CONTINUED

8000 series, which measures .87 by 6.25 by 3 inches (HWD) and fits into a vest pocket or purse.

The \$219.95 SF-7000 has 32K of memory, while the \$239.95 SF-7500 and \$259.95 SF-8000 have 64K. The screen sizes are the same for all models, and the only distinction in addition to physical and memory size is that the SF-7000 and 7500 use a flush keyboard with soft-touch membrane keys, while the SF-8000 has a raised-key keyboard with hard switches. Entering data on either keyboard is not as facile as it is using a full-sized desktop or laptop-sized PC keyboard, but the QWERTY layout helps. The software and memory configurations are also the same, as is the *PC-Link* software developed for Casio by Traveling Software.

Casio's newest offering is the SF-9000 Executive B.O.S.S., which has a retail price of \$299.95. It's the same size, with the same screen as the SF-8000, but it has the SF-7000's membrane keyboard and accommodates IC cards for memory and applications. The ES-100 64K card sets memory at 128K and costs \$129.95. Other cards include the \$129.96 ES-600 Houghton Mifflin electronic dictionary, the \$79.95 ES-610 financial speller, and the \$79.95 ES-620 medical speller.

The B.O.S.S. comes with two formats for entering names and addresses, both of which make lookups quick and easy. The Telephone Directory is oriented to people names, while the Business Card Directory is oriented to companies. Scheduling is also easy with entries available for dates, times and time ranges, along with unlimited text for any item. Data is sorted by date and time: you can set alarms, and search for free or busy times or for any character strings in a scheduled item. Casio's Memo organizer is handy for keeping track of credit card, passport, driving license, and other key numbers in your life, but don't think of it as a place to take notes during a long meeting.

Psion Organizer (201-274-7521) Though it looks more like a calculator than the other machines considered here, the Psion Organizer is a true com-

puter and a fairly powerful one. The Psion's small two-or-four line display is positioned atop the unit's 36-key keypad, which assigns two functions to most keys. Instead of disk drives, the Psion accommodates up to two datapak cartridges available in sizes up to 256K (maximum capacities vary by Organizer model), which slip into receptacles on the reverse side of the unit. The same receptacles also accept RAMPaks which look just like datapaks, but add system memory instead of storage.

Psion distributes software on ROM versions of these tiny cartridges. Among the programs available are a word processor, a math package, a personal finance program, and a spell checker. Psion also offers hardware accessories, including printers, a file transfer cable for use with your desktop system, and a Hayes-compatible modem that snaps conveniently into the Psion's top-mounted bus connector.

The 1.12-by-3-by-5.5-inch (HWD) Organizer comes in three basic versions, which differ in the amount of system memory they offer and how many lines their screens can display. The top-of-the-line \$299.99 Organizer II model LZ has 32K of internal RAM and displays four 20 character lines at a time. The display scrolls to reveal a full 80 character line. The \$249.99 Organizer II XP has 32K RAM and displays two lines at a time. The \$179.95 Organizer II CM sports 8K of RAM.

The Psion's built-in software includes a simple database for filing, a notepad (model LZ only), a clock and alarm, and a sophisticated calculator. Unlike the other sublaptops, the Psion comes with a built-in procedural programming language called OPL. The language is well integrated with the calculator; you can use the numeric OPL functions in your calculations.

The Psion is terrific for keeping track of small notes and other bits of information; the \$49.95 *Finance* soft-

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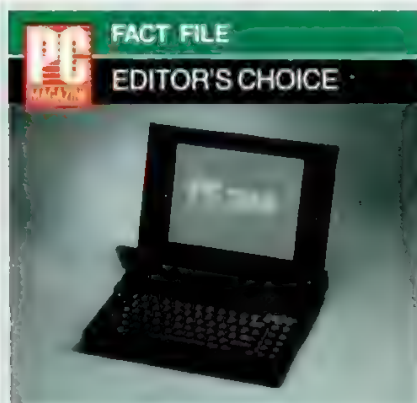
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there is also an external expansion bus connector for use with a not-yet-available expansion chassis that will probably have two, or perhaps three, 16-bit slots. Available now is a \$299 optional docking module that duplicates all the Dynabook's ports. At first this redundancy may not seem worth the money, but if you plug in lots of accessories and move the computer between locations, the docking module can save the aggravation of having to detach and later reattach the individual accessories; you just push the docking module into the back of the computer.

The unusual flat-format lead acid battery is rated to last for 2 to 4 hours. On our rundown test it kept going for 2 hours and 18 minutes. Recharging can take 12 hours, so using the Dynabook on the road for an extended time without AC power is possible only if you carry extra batteries, which, at 5.5 pounds apiece, are heavy.

The Dynabook 286 is sold only through dealers and comes with a one-year parts-and-labor warranty. Its price and modular design concept suggest a target market of traveling corporate types who want a classy machine for the road with few performance compromises. If you can leave docking modules, VGA monitors, and AC adapters at your regular computing locations, the 6.5-pound core component is so



Dynabook 286

Dynabook Technologies Corp., 1751 Fox Dr., San Jose, CA 95131; (800) 444-1598, (408) 452-1791.

List Price: With 1MB RAM, 20MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA transmissive supertwist LCD display, one parallel, two serial, one mouse port, DOS 4.01, SmartStart utility software, \$5,195; with 2MB RAM, 43MB hard disk, 2,400-bps modem, lead acid battery, \$7,042.

In Short: The Dynabook 286 is a very classy, fast 80286-based, modular computer. Depending on the modules you choose, it weighs between 6.5 and 16 pounds. It's best cast as a very flexible desktop component system that also can be used as a standalone portable.

CIRCLE 545 ON READER SERVICE CARD

CONTINUED

ware pack has a rudimentary but usable expense recorder that works well on business trips. The Psion's multiple alarms and world time clock add to its worth as a traveling companion.

Its biggest flaw is the alphabetically arranged keypad; typing on this thing, even after some practice, can be a maddening experience.

Sharp Wizard (1-800-BESHARP) The Wizard is probably the best known of the sublaptop computers on the market. It's been around the longest (over a year) and has the most marketing clout behind it. The OZ-7000 Wizard also has the most functionality—albeit at a price—of any sublaptop on the market.

The OZ-7000 Wizard has been roundly criticized for its ergonomics, especially the alphabetically arranged keyboard that dominates the right-hand side. It also suffers from the smallish, 16-character by 8-line screen located to the left of the keyboard instead of above it. Left-handers have a difficult time with its wrong-sidedness. Its size, however, is fine—at .87 by 6.37 by 3.75 inches (HWD), it fits comfortably in a vest pocket or purse. Although it's true that the Wizard is the only sublaptop with a standard ten-key numeric keypad, its applications are text-oriented.

There's no criticizing the Wizard's functionality. The basic \$299.99 Wizard comes with the same level of program capability as the B.O.S.S. or Portfolio, including its own optional version of *PC Link* from Travelling Software. Sharp also offers the \$169.66 CE-50P printer and \$159.99 CE-152 cassette recorder for its Wizard line. The Wizard's 32K memory can be expanded by adding a 32K or 64K RAM card that costs \$79.99 and \$129.99, respectively. Its functionality can be enhanced with Sharp's \$119.99 *Time and Expense Manager*, \$99.99 *Eight Language Translator*, \$129.99 *Dictionary and Thesaurus*, \$99.99 *Money Planner*, or \$79.99 *North American City Guide*. Card-based functions are accessed through a membrane-keyed touchpad. All expansion cards are battery-backed to maintain data while they're not installed in the Wizard.

By the time you read this, a 3-D spreadsheet card, a telecommunication card, and a scientific calculator card should be available. Sharp has also announced an E-P ROM card and developer's kit.

Tandy WP-2 (817-390-3487) If your travel computing needs boil down to writing and communicating, Tandy's \$349 WP-2 portable word processor may be all you need. At just over 3 pounds, the WP-2 is easy to carry, and its 1-by 11.75-by 8.5-inch (HWD) dimensions allow it to slip effortlessly into a brief case, portfolio, or shoulder bag. It runs on four AA batteries. Limitations include software that's less than state-of-the-art and the low-contrast 80-column by 8-line screen.

The Z80A-based WP-2 comes with built-in proprietary word processing software along with a few utilities like a phone list and a calendar. A terminal program lets you connect a modem to the rear-mounted RS-232 port for file transfer or access to online services. At 22K executable RAM, memory is quite limited. Tandy offers a \$49.95 storage expansion option that boosts internal storage for your files to a total of 64K RAM; \$119.95 32K IC cards slip into a slot on the side. An optional battery-powered external 3.5-inch floppy disk drive stores 200K on standard disks.

Choices, Choices If you're just interested in carrying your appointments and addresses in your pocket, go for the Casio B.O.S.S. Its QWERTY keyboard and normal screen-over-keyboard configuration make it comfortable to use, even though its ergonomics are not quite up to touch-typing standards. The Psion Organizer's and the Sharp Wizard's alphabetically arranged keyboards and smaller screens make life more complicated than necessary. If all you plan to do on your travels is word processing and communicating, the Tandy WP-2 may be a good choice. If you want PC-like features, the Atari Portfolio is more your style. It has better functionality and a familiar look and feel. Once Atari's communications software is out, this may be the best price-performance notetaker and communicator on the block. ■

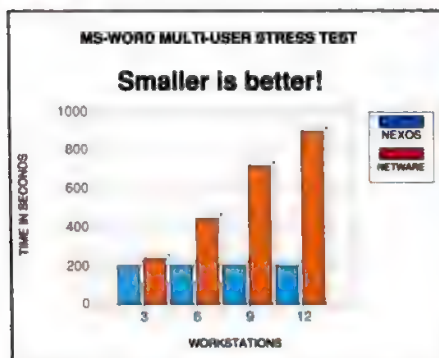
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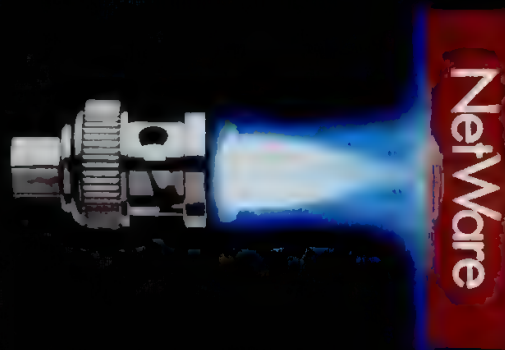
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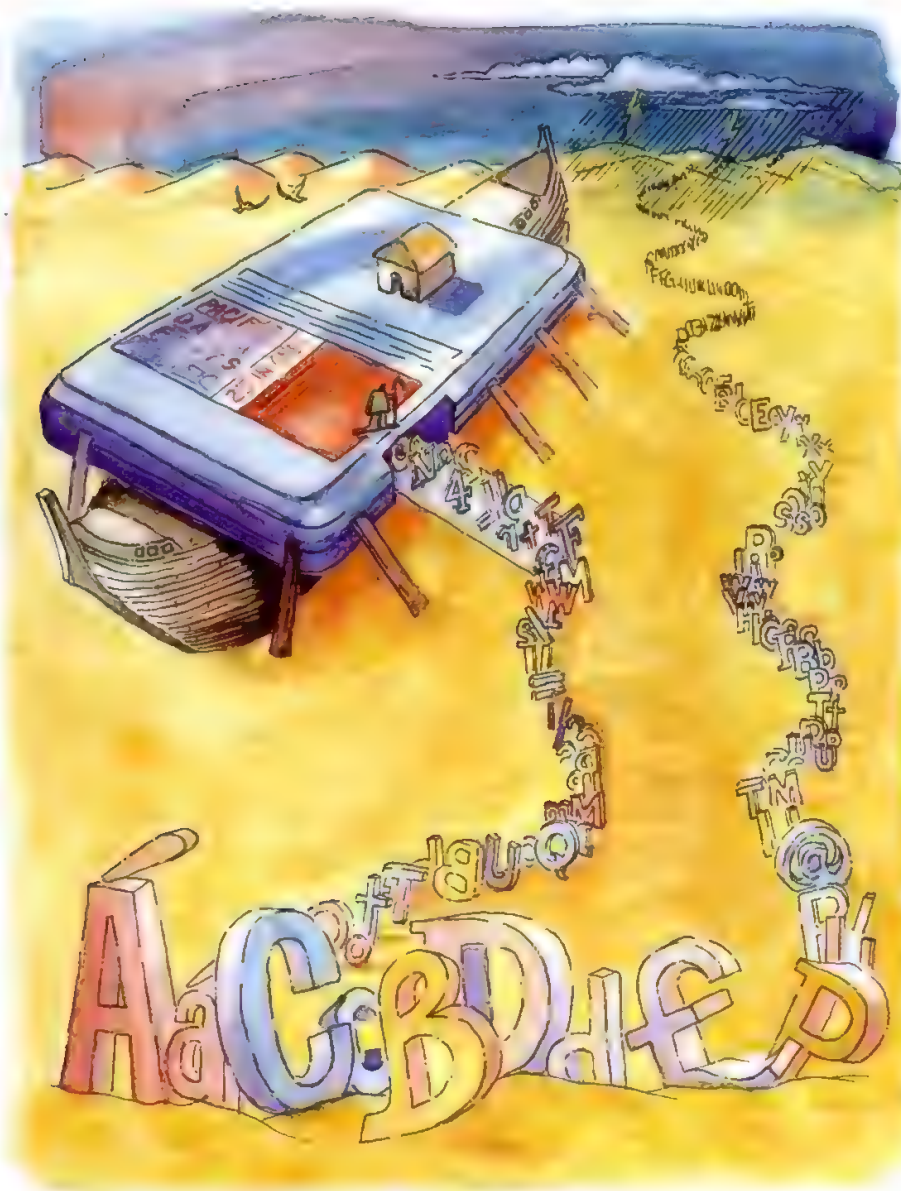
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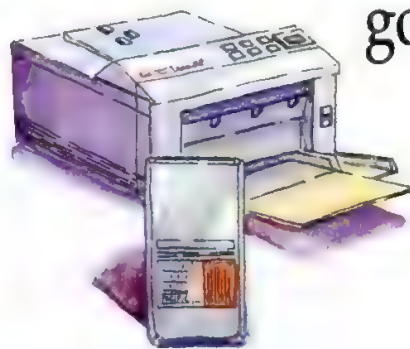
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easy to carry around that you'll seldom leave without it. When you do need a screen and battery, take those, too, with their extra weight, but only when you need them. I recommend this machine highly for anyone who needs fast, classy, flexible computing.

EPSON AMERICA INC.

Epson Equity LT-286e

by Bruce Brown

Even though the Epson LT-286e, with 1MB RAM, hard disk, 1.44MB floppy disk drive, and EGA supertwist LCD display lists for \$4,599 and appears similar to other top-of-the-line 286 portables, don't let its average appearance fool you. Unlike other 286-based laptops, the 12 MHz LT-286e offers something unusual: the choice of removable 20MB and 40MB Conner hard disk drives.

The removable hard disk drives, its best feature, furnish easy extra storage for your laptop, not to mention an extra level of data security when you're not using the computer. And if you want to use the hard disks on a desktop machine, Manzana MicroSystems sells the DrivePort, an external drive receptacle for the Epson removable hard disk. With a controller card and cabling, the DrivePort costs less than \$300. An Equity LT-286e with a 40MB hard disk costs \$4,999. Extra hard disk drives cost \$899 for 20MB and \$1,299 for 40MB units.

The LT-286e's second-best feature is its 640- by 480-pixel black-on-white EGA display capable of 16 shades of gray, making the 8.25- by 6.25-inch (WH) screen fine for graphics. A 9-pin, external monitor port is standard.

The LT-286e's 84-key keyboard includes ten function keys and a combined PC-style numeric and cursor-control keypad. Oddly, the ESC key is placed below the F1 key, and the long reach to the upper-right side of the keyboard for the cursor keys makes word processing tasks a bit awkward. Luckily, the LT-286e includes a standard external keyboard jack for desktop use.

At just over 17 pounds, including its battery, the LT-286e is no lightweight. It measures 3.5 by 12.8 by 14 inches (HWD) with the battery pack attached to the back. Without the 4-pound battery, which ran 2 hours and 16 minutes in our tests, the LT-286e loses 2.75 inches of its depth. The

PORTABLE 286-BASED

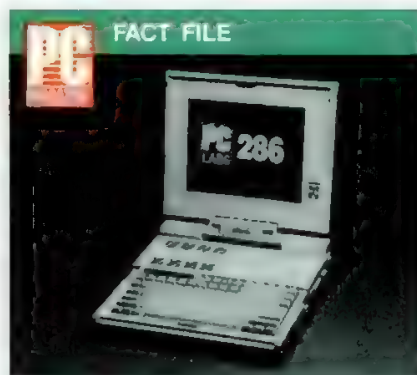
computer's AC adapter weighs just under 3 pounds and is bulky—about the size of a paving brick. With both the battery and AC adapter, the package totes just shy of 20 pounds, not including the weight of the carrying case and a cable or two.

The light beige case sports a 1MB memory card expansion slot, an internal modem slot, and space for a two-thirds' length ISA 16-bit expansion card. There's also a small LCD window that indicates processor speed, battery life, drive access, display selection, and key lock status. A full-length handle makes it easy to move the LT-286e short distances.

You can reach the 2MB RAM total by adding a \$499 1MB memory card, but you can get around this limit by using the 16-bit slot if you can find a short 16-bit memory expansion card. However, you will lose the slot for connectivity purposes.

Epson sells only through dealers, and the company's machines are serviced nationwide at authorized service centers. Discounts from the list price are often available on Epson products.

The LT-286e certainly isn't as light as the notebook computers nor as expandable as some lunchbox-style portables. But the LT-286e possesses one impressive difference: removable hard drives that add greater data portability and security.



Epson Equity LT-286e

Epson America Inc., 2780 Lomita Blvd., Torrance, CA 90505; (800) 922-8911.

List Price: With 1MB RAM, 20MB hard disk, 1.44MB 3.5-inch floppy disk drive, EGA supertwist backlit LCD display, one parallel and one serial port, Turbo EMS 4.2, power-saving utilities, MS-DOS 4.01, \$4,599; with 40MB hard disk, \$4,999.

In Short: Epson's terrific 286 laptop combines ingenious, modular case design with an admirable EGA-mode screen and a unique removable hard disk drive. At 17 pounds, the LT-286e isn't the lightest laptop around, but it may be one of the most useful.

CIRCLE 546 ON READER SERVICE CARD

GRID SYSTEMS CORP.

GRiDCase 1520

by Catherine D. Miller

GRiD Systems hasn't made many design changes in the two-year-old GRiDCase 1520. Its sleek black magnesium case, measuring 2.3 by 11.5 by 15 inches (HWD), is still a standout in the portable crowd, although its keyboard is still one of the most unpleasant. However, brilliant VGA graphics in a backlit LCD display give this veteran a pleasing new face.

Based on Intel's 12-MHz 286 running at 10 or 6 MHz, the GRiDCase 1520 is not built for speed. Neither is it an inexpensive 286 laptop alternative. Our \$6,715 evaluation unit included 1MB RAM, a 1.44MB floppy disk drive, a 40MB hard disk, VGA backlit LCD display, one parallel and two serial ports, a 2,400-bit-per-second internal modem with a dual phone jack, and DOS 3.3.

Weighing about 13 pounds in this configuration with battery pack included, the GRiDCase 1520 is still one of the lighter 286-based laptops. The downsized keyboard's center-to-center key spacing is a standard .75 inches, but the keys are wider at the top than standard keys, which makes them too close for comfortable typing. The 72 keys are poorly arranged, with backspace and function keys in especially uncomfortable positions.

GRiD incorporates several interesting design features in its GRiDCase product line. One or two ROM chips, holding 256K each, offer additional storage for applications you commonly use. The ROM storage compartment is easily accessible in front of the keyboard. GRiD offers a DOS 3.3 ROM chip for \$150; alternatively, you can burn in your own custom applications. A power pack slot designed to hold a battery pack, AC power pack, and 3270 or Ethernet cartridge sits in the rear of the unit. Connect to the network with the Ethernet cartridge when you're in the office; when you're on the road, load the battery pack.

Weighing slightly over a pound, the removable nickel cadmium battery pack is compact power that travels well. Unfortunately, battery life lasted less than an hour in the PC Labs rundown test, making it mandatory to bring several packs on nearly any trip. The 60-watt AC power pack, designed to be used internally in the power-pack slot or externally to power the unit

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CIRCLE 211 ON READER SERVICE CARD

PORTABLE 286-BASED

and charge the battery, weighs less than a pound. Installing the AC power pack in the power-pack slot didn't present the same heating problems we experienced with the GRiDCase 1530 (reviewed in the 386 section).

Probably the most impressive feature is the VGA backlit LCD display. Reasonably good contrast, a 1.33 aspect ratio, and a color-mapped 32-shade gray scale made this display stand out on our graphics tests. You can also customize the color mapping to work better with your applications. However, the screen did have some problems with blooming that resulted in uneven background saturation.

Compared with other 286-based portables, the GRiDCase 1520 turned in some of the slowest times on our processor and memory performance tests. Its times on our disk tests were more in line with those of the competition. The video BIOS times were competitive but relatively slow in writing to the screen.

In addition to our evaluation unit's \$1,675 40MB hard disk and \$695 2,400-bps modem, other GRiD internal options include a \$495 10-MHz 80287 coprocessor and a \$2,895 100MB hard disk. The 100MB hard disk occupies both drive bays, so you must give up your floppy disk drive. The motherboard accepts up to 4MB of DRAM, using eight SIP modules.

The GRiDCase 1520 has been around for a while, and its age is beginning to

show. To its credit, GRiD has updated its display options to include a great-looking VGA-resolution backlit LCD screen. And some of its older features—expansion options, power options, lighter weight, and a stylish case—are still winners. But its unpleasant keyboard, limited battery life, weak performance, and high price tag make it less attractive in today's upscale portable market.

HYUNDAI ELECTRONICS AMERICA **Hyundai Super-LT3** by Bruce Brown

Hyundai's Super-LT3, a 10-MHz 80286-based battery-operated laptop, gives you a lot of performance for a relatively low list price. CGA graphics, limited expansion, and slow speed are the trade-offs you make for the bargain.

The \$2,995, 80286-based 10-MHz Super-LT3 ships with 1MB RAM, a 27-millisecond Connors 20MB hard disk drive, 1.44MB floppy disk drive, an acceptable backlit supertwist LCD CGA display, one serial and one parallel port, an external monitor, floppy disk drive ports, and MS-DOS 3.3. The Hyundai is 2.75 by 13 by 13 inches (HWD) and at nearly 13 pounds weighs a bit less than most 80286-based laptops.

Unfortunately expansion on the Super-LT3 is limited. You can add a third-party 1MB SIMM module to increase the system to its 2MB maximum. You can also add an internal modem. There are no hard disk and no expansion chassis or docking station options. In addition to the usual switches and indicators, Hyundai has included a side-mounted reset button.

Hyundai makes its own motherboard and uses the Award ROM BIOS with its internal setup and diagnostics routines. The standard memory module uses 256-kilobit ZIP-style 100-nanosecond DRAM chips. The memory runs at one wait state. The Super-LT3's performance on the PC Labs benchmark tests are acceptable but not outstanding.

The LCD display looks good, but at 9.5 by 4.5 (HW) inches, its 2.28 aspect ratio results in flattened graphics. The screen will display four shades of gray and the graphics modes produce images of passable quality, but this machine is clearly not suited for your needs if you are required to

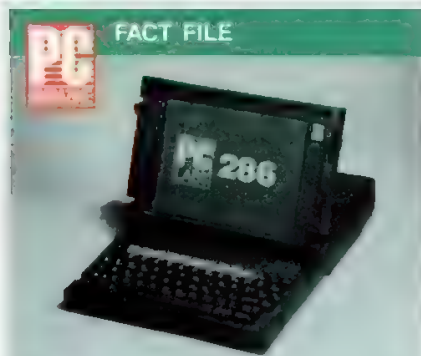
perform intensive graphics work.

The 77-key keyboard is set back a bit from the front of the case, leaving enough room for a wrist-rest, but is a disappointment because of one feature: in order to use the Home, End, PgDn, and PgUp keys you must engage NumLock. There is an embedded numeric keypad also turned on by the NumLock key, but because this keyboard lacks a separate function key, the only way to use the keypad or the page movement keys is with the extra keystroke to engage the NumLock key and then another superfluous movement to disengage NumLock. The keyboard's layout is otherwise fine. There is no external keyboard port.

The nickel cadmium battery clocked 2 hours and 45 minutes of service on our battery rundown test, almost matching its rated 3-hour duration. Recharging takes approximately 8 hours. Extra batteries will be available, but prices were unavailable at the time of this review. At 8 by 3.5 by 2.25 inches (HWD), the standard AC adapter/battery charger is larger than normal and may prove awkward if you need to take it with you.

Hyundai computers are sold only by dealers and come with an 18-month parts-and-labor dealer-service warranty.

The Hyundai Super-LT3's price is right for a 286 machine with good battery life, even if it does run only at 10 MHz and offers only CGA graphics capability. If you're looking for something that's light enough to take with you but don't want to



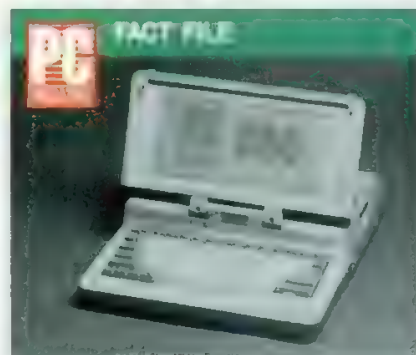
GRiDCase 1520

GRiD Systems Corp., 47211 Lakeview Blvd., P.O. Box 5003, Fremont, CA 94537-5003; (800) 222-4743, (415) 656-4700.

List Price: With 1MB RAM, two 1.44MB 3.5-inch floppy disk drives, CGA liquid crystal display, one parallel and two serial port, \$3,495; with 20MB hard disk, VGA liquid crystal display, DOS 3.3, \$5,870; with 40MB hard disk, 2,400-bps internal modem, \$6,715.

In Short: The GRiDCase 1520's attractive styling, plentiful expansion options, and dazzling VGA graphics are marred by a 10-MHz 286, slow memory, and a high price tag.

CIRCLE 547 ON READER SERVICE CARD



Hyundai Super-LT3

Hyundai Electronics America, 166 Baypointe Pkwy., San Jose, CA 95134, (800) 727-6972, (408) 473-9200

List Price: With 1MB RAM, 20MB hard disk, one 1.44MB 3.5-inch floppy disk drive, CGA liquid crystal display, one parallel and one serial port, MS-DOS 3.3, GW-BASIC, \$2,995

In Short: Hyundai's lightweight 80286-based laptop is marred by an awkward keypad arrangement. Its CGA screen is fine for text but limited for graphics.

CIRCLE 548 ON READER SERVICE CARD

shell out the big bucks for an 80286-based notebook machine—and if you don't need presentation-level graphics—give this Hyundai a look.

INTERNATIONAL INSTRUMENTATION INC.

Blue Max Attache 286

by Bill O'Brien

The Blue Max Attache 286 is the more mundane of the two portables submitted by International Instrumentation Inc.—a.k.a. I3—for this review. As with its 386 counterpart (reviewed in the 386 section), the term “portable” is only loosely applied to the bloated 8.5- by 17.5- by 16.75-inch (HWD) briefcase-style enclosure. Certainly, its 32-pound bulk makes this \$2,979 machine more suited to luggage carts than to even the strongest right arms. There is no sense in denying that unlike the majority of portables that pretend to have desktop capability, this is actually a full-featured desktop unit that aspires to transportability.

Like the Blue Max Attache 386, the 286 model arrived with a HGA/CGA-compatible monochrome display (but here driven by an EGA card). Also like the 386,



Blue Max Attache 286

International Instrumentation Inc., 2282 Townsgate Rd., Westlake Village, CA 91361; (800) 543-DISK, (800) 346-DISK (in Calif.), (805) 495-7673.

List Price: With no RAM, 1.2MB 5.25-inch floppy disk drive, HGA/CGA multiscanning monochrome display, \$1,596; with 1MB RAM, 20MB hard disk, DOS 3.3, \$2,235; with 4MB RAM, 42MB hard disk, one 1.2MB 5.25-inch and one 1.44MB 3.5-inch floppy disk drive, one parallel and two serial ports, \$2,979.

In Short: The Attache 286 is an outrageously large machine to be called a portable, but it does have a handle and is only a third heavier than most of the lunchboxes—all the while maintaining performance levels equivalent to those of the IBM 73-121.

CIRCLE 606 ON READER SERVICE CARD

PORTABLES 286-BASED

it uses the same comfortable 83-key Cherry switch keyboard, but that's where the similarity ends. Inside the enclosure, the 20-MHz Attache 286 is complete with all of the tributes to medium technology demanded by a 16-bit environment.

The eight-slot motherboard, manufactured by the Standard Computer Corp., uses a Chips and Technologies chip set and is guided by an Award 286 Modular BIOS. Two slots are lost to the overhang of the video display; another is given up to the Western Digital controller that's tied into the 42MB 3.5-inch Fujitsu hard disk. Like its more powerful sibling, there is sufficient room inside the Attache 286's box for two such hard drives, even with dual floppies installed, and all drives are quad-shock-mounted to protect against the thumps and bumps of over-the-road travel. After the video and parallel/serial cards are accounted for, three 8-MHz 16-bit expansion slots are left to your discretion.

Most notably, the motherboard is actually an active backplane, and the 80286 electronics are packed on a CPU card nestled into a proprietary slot positioned down at the lower-left quadrant of the board. The processor card itself is a half-length device, leaving ample room for a standard half-length card in the adjacent 8-bit slot. For a mere \$330, I3 will exchange that card for a 386SX CPU board, bumping you into the world of 386 processing. Because the 80386SX is, externally, a 16-bit device, it takes only two jumper changes to acquaint all of the other electronics with their new brain.

That typifies I3's sales philosophy as well. One look at its product sheets and you'll quickly realize that you can have them assemble almost any style of computer you could possibly want with nearly any combination of components. For example, the Attache series normally uses an internally connected keyboard that is not replaceable. You can request that I3 include an optional external connector.

The Blue Max Attache 286 is no performance slouch. Indeed, its benchmark test results place it almost at the top of the 80286 heap, where it butts heads with the Micro Express Regal 286 for king-of-the-hill honors. In the big picture of portables, the Attache 286 has roughly the equivalent performance of a 386-based IBM Model 73-121. That level of functionality can make the effort needed to carry the box more than worthwhile.

KISS COMPUTER CORP.

KISS TL-3240EL

by Bruce Brown

The KISS TL-3240EL is a heavy 20 pound 12-MHz 286 laptop with an amber electroluminescent CGA display and two standard expansion slots: one 8-bit and one 16-bit. An AC power supply and internal lead-acid battery are both built in, explaining the extra weight. The KISS machine is at its best when viewed as a desktop model that you may want to take on the road occasionally.

The KISS's \$3,995 list price includes 1MB RAM (expandable to 4MB), a 43MB hard disk, 1.44MB 3.5-inch floppy disk drive, CGA electroluminescent monitor, one parallel and two serial ports, and your choice of DOS 3.3 or 4.01.

The dark-gray KISS case measures 4 by 14.75 by 15.63 inches (HWD), which is larger than most other laptops. Weighing close to 21 pounds, the standard carrying case comes with a convenient shoulder strap that is a necessity, although the computer itself has a reasonably sturdy full-width carrying handle.

The KISS electroluminescent screen has amber characters on a dark background. Contrast and brightness controls are absent, but you won't miss them. The display produces four true shades and can



KISS TL-3240EL

KISS Computer Corp., 2604 Washington Rd., Kenosha, WI 53140-2375; (800) GET-KISS, (414) 652-5477.

List Price: With 1MB RAM, 43MB hard disk, 1.44MB 3.5-inch floppy disk drive, CGA electroluminescent display, one parallel and two serial ports, DOS 3.3 or 4.01, \$3,995.

In Short: The KISS laptop is heavy and doesn't have a long battery life, but the electroluminescent screen is pleasant to look at, even in CGA mode. If you need a 286 machine with two built-in expansion ports and a good screen, the KISS's price is an attention-getter.

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Recently, Dr. Pournelle looked at Northgate's
80386 Pipeline Page Mode system and reported
in BYTE July, 1989 (excerpted):

*Jerry Pournelle holds a doctorate in psychology and is a
writer who also earns a comfortable living writing
about computers present and future.



"... the case is sturdy, and the motherboard construction is clean and neat. The boards are thick; I've seen some clones with boards so thin they wave in the breeze."

"... I like this machine a lot."

"... The workmanship is superior."

"... there sure wasn't any installation required for this system. I just turned it on, and it came up in MS-DOS 4.01."

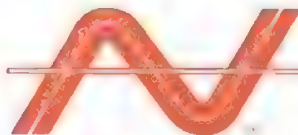
[a software program] ... "which is all graphics is almost twice as fast on the Northgate 80386 as on my other machines. So is Windows ..."

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PORTABLES 286-BASED



286-BASED PORTABLES: SUMMARY OF FEATURES

	Altima One	Blue Max Attache 286	Bondwell B310	CD Technology Portable	Compaq LTE/286	Compaq Portable III	Compaq SLT/286	Data World Portacom II 286-16
Price of standard configuration	\$2,799	\$2,979	\$3,695	\$4,795	\$5,318	\$4,999	\$6,218	\$2,630
TESTED CONFIGURATION								
Microprocessor	12-MHz 80286	20-MHz 80286	12-MHz 80C286	10-MHz 80C286	12-MHz 80286	12-MHz 80286	12-MHz 80286	16-MHz N80L286
Power supply type	Battery	AC only	Battery	AC only	Battery	AC only	Battery	AC only
Case type	Clamshell	Briefcase	Clamshell	Lunchbox	Notebook	Lunchbox	Lunchbox	Lunchbox
Dimensions (HWD, in inches)	3.9 x 11.8 x 15.7	8.5 x 17.5 x 16.8	2.3 x 13 x 12.8	9.8 x 16 x 8.8	1.9 x 11 x 8.5	9.8 x 16 x 7.8	4.1 x 13.5 x 8.5	9.5 x 15.5 x 8
Weight (lbs.)	15	32	8	23.9	7	20	14	21.8
Display system	CGA	CGA	CGA	CGA	VGA	CGA	VGA	EGA
Display technology	Liquid crystal	Monochrome CRT	Liquid crystal	Gas plasma	Electroluminescent LCD	Gas plasma	Liquid crystal	Gas plasma
Maximum resolution (pixels)	600 x 400	720 x 348	640 x 200	640 x 480	640 x 200	640 x 400	640 x 480	640 x 350
Motherboard manufacturer	Sampo	Standard Computer Co.	Bondwell	ELT	Compaq	Compaq	Compaq	Synaptix
Chip set manufacturer	Chips and Technologies	Chips and Technologies	Texas Instruments	Chips and Technologies	Compaq	Compaq	Compaq	ZyMos
System RAM arrangement	Interleaved	Row/column	Row/column	Row/column	Row/column	Row/column	Row/column	Proprietary
Wait states	0.7	0	0	0	Less than 1	1	1	0
MOTHERBOARD MEMORY								
Installed RAM	1MB	4MB	1MB	640K	640K	640K	640K	4MB
Maximum installable RAM	5MB	8MB	1MB	1MB	640K	640K	3MB	4MB
RAM packaging and rated speed	SIMM (80 ns.)	SIMM (100 ns.)	DIP (80 ns.)	DIP (100 ns.)	DIP (100 ns.)	DIP (100 ns.)	SIMM (120 ns.)	SIMM (80 ns.)
Chip size	256Kb	1Mb	256Kb	64Kb, 256Kb	64Kb, 256Kb	256Kb	1Mb	8 x 1Mb
ADD-IN MEMORY BOARD								
Installed RAM	N/A	N/A	N/A	N/A	2MB	512K	N/A	N/A
Maximum installable RAM	N/A	N/A	N/A	N/A	2MB	6MB	N/A	N/A
RAM packaging and rated speed	N/A	N/A	N/A	N/A	DIP (100 ns.)	DIP (100 ns.)	N/A	N/A
Chip size	N/A	N/A	N/A	N/A	256Kb	256Kb	N/A	N/A
BIOS								
BIOS version and date	Award 3.03 (May 1989)	286 Modular BIOS, 0N3.03 (January 1988)	Award 3.03 (October 1989)	Award 3.03 (November 1985)	Compaq (September 1989)	Compaq REV K (January 1987)	Compaq REV H.5 (B) (April 1989)	AMI (April 1989)
Password in ROM	■	□	□	□	■	□	□	□
Video shadowing	□	■	□	□	□	□	□	■
System shadowing	■	■	┘	┘	┘	┘	┘	■
HARD DISK								
Manufacturer	Conner	Fujitsu	Conner	Conner	Conner	Conner	Conner	Conner
Disk capacity	20MB	42MB	40MB	20MB	20MB	20MB	20MB	104MB
Interface	IDE	ST-506	IDE	IDE	ST-506	ST-506	IDE	IDE
Average access time (milliseconds)	25	30	25	19	28	28	29	28
Controller manufacturer	Conner	Western Digital	Conner	Conner	Conner	Conner	Conner	Conner
Hard disk options	40MB IDE	Varies with dealer	None	40MB IDE	40MB ST-506	None	40MB IDE	43MB, 104MB SCSI
INTERNAL FLOPPY DISK DRIVE								
Capacity	1.44MB	1.44MB, 1.2MB	1.44MB	1.44MB	1.44MB	1.2MB	1.44MB	1.44MB
Size	3.5-inch	3.5-, 5.25-inch	3.5-inch	3.5-inch	3.5-inch	5.25-inch	3.5-inch	3.5-inch
Manufacturer	TEAC	Toshiba, Fujitsu	TEAC	TEAC	Sony	Sony	Sony	Sony
EXPANSION								
Bus speeds (MHz)	8	8	12	8	8	8	8	8, 10.6
Expansion slots	One 8-bit	Two 8-bit, six 16-bit	None	Two 8-bit, six 16-bit	Two proprietary	None	None	Two 8-bit, four 16-bit
Available slots	1	4	N/A	1	1	N/A	N/A	2
Drive bays	2 half-height	1 full-height, 2 half-height	2 half-height	3 half-height	2 half-height	2 half-height	2 half-height	2 half-height

■—Editor's Choice ■—Yes □—No

N/A—Not applicable: the product does not have this feature.

PORTABLES 286-BASED

Dauphin LapPRO-286 \$3,195	Dolch P.A.C. 286-12 \$4,145	Dolch P.A.C. 286-16 \$5,145	Dynabook 286 \$5,195	Epson Equity LT-286e \$4,599	GRIDCase 1520 \$5,870	Hyundai Super-LT3 \$2,995	KISS TL-3240EL \$3,995	LapPower 286/20 \$4,299	Maxtron PC III 286 \$3,398
12-MHz 80286	12-MHz 80286	16-MHz 80286	16-MHz 80C286	12-MHz 80C286	10-MHz 80286	10-MHz 80C286	12-MHz 80C286	12-MHz 80286	12-MHz 80286
Battery	AC only	AC only	Battery	Battery	Battery	Battery	Battery	Battery	AC only
Clamshell	Lunchbox	Lunchbox	Clamshell	Clamshell	Clamshell	Clamshell	Clamshell	Clamshell	Lunchbox
15.9 x 12.6 x 3	9.5 x 15.8 x 8.2	9.5 x 15.8 x 8.2	2.4 x 13.6 x 11	3.5 x 12.9 x 14	2.3 x 11.5 x 15	2.75 x 13 x 13	4 x 14.8 x 15.6	4 x 13.75 x 8.5	9.75 x 16.1 x 8.75
16.7	20.8	20.8	14.5	17	13	12.8	20.8	13.6	23.6
CGA	CGA	CGA	VGA	EGA	VGA	CGA	CGA	VGA	VGA
Liquid crystal	Electroluminescent	Electroluminescent	Liquid crystal	Liquid crystal	Liquid crystal	Liquid crystal	Electroluminescent	Liquid crystal	Gas plasma
720 x 400	640 x 400	640 x 400	640 x 480	640 x 480	640 x 480	640 x 200	640 x 400	640 x 480	640 x 480
Dauphin	Monolithic Systems	Monolithic Systems	Dynabook	Epson	GRID Systems	Hyundai	KISS	Vendata	C&D Technology
VLSI	G2	G2	Dynabook	Epson	Faraday	Hyundai	Suntac	Western Digital	C&D Technology
Row/column	Row/column	Row/column	Row/column	Row/column	Row/column	Row/column	Row/column	Interleaved	Interleaved
0	0	0	0	1	1	1	1	0	0
1MB	1MB	2MB	2MB	1MB	1MB	1MB	1MB	1MB	1MB
4MB	4MB	4MB	4MB	2MB	4MB	1MB	4MB	8MB	4MB
DIP (100 ns.)	DIP (80 ns.)	DIP (70 ns.)	SIMM (80 ns.)	DIP (100 ns.)	SIP (120 ns.)	ZIP (100 ns.)	DIP, ZIP (100 ns.)	SIMM (100 ns.)	DIP (100 ns.)
256Kb	256Kb	1Mb	256Kb, 1Mb	256Kb	256Kb	256Kb	256Kb	256Kb	256Kb
N/A	N/A	N/A	N/A	N/A	N/A	None	N/A	N/A	None
N/A	N/A	N/A	N/A	N/A	N/A	1MB	N/A	N/A	16MB
N/A	N/A	N/A	N/A	N/A	N/A	DIP (100 ns.)	N/A	N/A	DIP (100 ns.)
N/A	N/A	N/A	N/A	N/A	N/A	256Kb	N/A	N/A	256Kb
AMI (1987)	AMI (January 1988)	AMI (January 1988)	Phoenix 3.10.00 (January 1988)	AMI (February 1989)	Phoenix 3.06 (August 1989)	Award L3.306 (July 1989)	Award 3.03GS (November 1985)	Award F3.04PV (1989)	EMI (1989)
□	□	□	□	□	■	□	□	□	□
□	■	■	□	□	■	□	□	■	■
□	■	■	□	□	□	□	□	■	■
Conner	Toshiba	Toshiba	Conner	Conner	Conner	Conner	Conner	Conner	Toshiba
40MB	40MB	40MB	43MB	40MB	40MB	21MB	43MB	21MB	44MB
ST-506	ST-506	ST-506	IDE	ST-506	ST-506	IDE	IDE	RLL	ST-506
26	25	25	28	25	25	27	28	28	28
Conner	NCO	NCO	Conner	Epson	GRID Systems	Conner	Conner	Conner	Adaptec
20MB, 100MB ST-506	100MB, 150MB ESDI; 100MB, 170MB SCSI	100MB, 150MB ESDI; 100MB, 170MB SCSI	None	20MB, 40MB IDE	20MB, 100MB ST-506	None	None	40MB ST-506	20MB ST-506
1.44MB	1.2MB	1.2MB	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB, 1.2MB
3.5-inch	5.25-inch	5.25-inch	3.5-inch	3.5-inch	3.5-inch	3.5-inch	3.5-inch	3.5-inch	3.5-, 5.25-inch
Sony	Toshiba	Toshiba	Sony	Epson	Epson	Epson	Toshiba	Citizen	TEAC
12	6, 12	8, 16	8	8, 12	5, 8	8	8	N/A	8
None	One 8-bit, seven 16-bit	One 8-bit, seven 16-bit	None	One 16-bit	None	Two proprietary	One 8-bit, one 16-bit	None	Two 8-bit, one 16-bit
N/A	2	2	N/A	1	N/A	2	None	N/A	1
2 half-height	2 half-height	2 half-height	2 half-height	2 proprietary	2 half-height	2 half-height	2 half-height	2 half-height	3 half-height

CONTINUES

PORTABLES

286-BASED

286-BASED PORTABLES: SUMMARY OF FEATURES

	Micro Express Lyte-Byte 3400 \$2,495	Micro Express Regal 286 \$2,074	Mitsuba Ninja-12 VGA \$3,595	Mitsubishi MP 286L/240EVP \$4,795	NEC PowerMate Portable Plus \$4,999	NEC ProSpeed 286 \$5,099	Packard Bell PB286LP \$3,995	PC Brand Portable PC III 286/12 \$3,145
TESTED CONFIGURATION								
Price of standard configuration								
Microprocessor	16-MHz 80C286	20-MHz 80C286	12-MHz 80C286	12-MHz 80286	12-MHz 80286	16-MHz 80286	12-MHz 80C286	12-MHz 80286
Power supply type	AC only	AC only	Battery	AC only	AC only	Battery	Battery	AC only
Case type	Clamshell	Lunchbox	Clamshell	Clamshell	Lunchbox	Clamshell	Clamshell	Lunchbox
Dimensions (HWD, in inches)	3.7 x 14.8 x 13.4	9.8 x 16 x 8.3	3.3 x 12.6 x 13.5	3.5 x 12.3 x 14.2	11.25 x 16 x 8	3.6 x 12.8 x 14.75	3.2 x 12.8 x 13.5	9.1 x 16 x 7.5
Weight (lbs.)	16.8	22.8	16.6	15.9	20.6	16	16.1	24.5
Display system	EGA	EGA	VGA	EGA	VGA	VGA	CGA	VGA
Display technology	Gas plasma	Gas plasma	Liquid crystal	Liquid crystal	Liquid crystal	Liquid crystal	Liquid crystal	Gas plasma
Maximum resolution (pixels)	640 x 400	640 x 400	640 x 480	640 x 400	640 x 480	640 x 480	640 x 400	640 x 480
Motherboard manufacturer	Chicom	InformTech	Quanta	Mitsubishi	NEC	NEC	Packard Bell	PC Brand
Chip set manufacturer	Chips and Technologies	Chips and Technologies	Chips and Technologies	Mitsubishi	NEC	Chips and Technologies	Intel	Chips and Technologies
System RAM arrangement	Interleaved, page mode	Interleaved, page mode	Interleaved	Row/column	Interleaved, page mode	Interleaved, page mode	Row/column	Interleaved
Wait states	0	0	0	1	0	0.7	1	0
MOTHERBOARD MEMORY								
Installed RAM	1MB	4MB	1MB	640K	1MB	1MB	1MB	4MB
Maximum installable RAM	1MB	4MB	5MB	640K	1MB	1MB	5MB	4MB
RAM packaging and rated speed	DIP (80 ns.)	DIP (80 ns.)	SIMM (100 ns.)	DIP (100 ns.)	SIP (80 ns.)	DIP (100 ns.)	SIMM (100 ns.)	SIP (100 ns.)
Chip size	1Mb	1Mb	1Mb	64Kb, 256Kb	1Mb	1Mb	1Mb	1Mb
ADD-IN MEMORY BOARD								
Installed RAM	4MB	N/A	N/A	2MB	None	None	N/A	N/A
Maximum installable RAM	4MB	N/A	N/A	2MB	3MB	4MB	N/A	N/A
RAM packaging and rated speed	DIP (80 ns.)	N/A	N/A	DIP (100 ns.)	SIP (80 ns.)	DIP (100 ns.)	N/A	N/A
Chip size	1Mb	N/A	N/A	64Kb, 256Kb	1Mb	1Mb	N/A	N/A
BIOS								
BIOS version and date	AMI (September 1988)	Award 303.22 (November 1985)	Award 3.03 (1988)	Phoenix 3.10.00 (January 1988)	Phoenix 3.10.65 (January 1988)	Phoenix 3.10.05 (January 1988)	Award 0N3.03 (November 1985)	AMI (March 1989)
Password in ROM	☐	☐	☐	☐	☒	☒	☒	☐
Video shadowing	☒	☒	☐	☐	☒	☒	☐	☒
System shadowing	☒	☒	☒	☐	☒	☒	☒	☒
HARD DISK								
Manufacturer	Conner	CDC	Conner	NEC	NEC	Conner	Conner	Miniscrite
Disk capacity	94MB	177MB	40MB	40MB	42MB	21MB	40MB	71MB
Interface	IDE	ESDI	ST-506	ST-506	ST-506	IDE	IDE	ST-506
Average access time (milliseconds)	23	15	27	25	28	27	28	18
Controller manufacturer	Conner	DTC	Quanta	Western Digital	National	Conner	Conner	Adaptec
Hard disk options	100MB ESDI	100MB ESDI; 40MB IDE	None	None	100MB ESDI	None	None	40MB, 66MB, 110MB ST-506, 150MB ESDI
INTERNAL FLOPPY DISK DRIVE								
Capacity	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB
Size	3.5-inch	3.5-inch	3.5-inch	3.5-inch	3.5-inch	3.5-inch	3.5-inch	3.5-inch
Manufacturer	Epson	TEAC	Mitsuba	Mitsubishi	NEC	TEAC	TEAC	TEAC
EXPANSION								
Bus speeds (MHz)	8	8	12	12	8	8	6, 12	8
Expansion slots	Two 16-bit	Three 8-bit, five 16-bit	One proprietary	Four proprietary	Three 16-bit	One proprietary	One proprietary	Two 8-bit, six 16-bit
Available slots	1	2	1	3	2	1	1	2
Drive bays	2 half-height	2 half-height	2 half-height	2 half-height	2 half-height	2 half-height	2 half-height	3 half-height

☒ —Editor's Choice
 ☒ —Yes
 ☐ —No

N/A—Not applicable: the product does not have this feature

PORTABLES

286-BASED

PC Brand Portable PC III 286/20 \$3,337	Sharp PC-5541 \$6,440	Tandon LT/286 \$3,874	Toshiba T1600/40 \$5,199	Toshiba T3100e/40 \$4,299	TravelMate LT286 Model 12 \$4,199	TravelMate LT286 Models 25 and 45 \$4,999	UNIQ/PhD Laptop 286-12 \$2,595	Zenith SupersPort 286e \$5,499
20-MHz 80286	12-MHz 80286	12-MHz 80C286	12-MHz 80286	12-MHz 80286	12-MHz 80286	12-MHz 80286	12-MHz 80286	12-MHz 80286
AC only	Battery	Battery	Battery	AC only	Battery	Battery	AC only	Battery
Lunchbox	Clamshell	Clamshell	Clamshell	Clamshell	Notebook	Clamshell	Clamshell	Clamshell
9.1 x 16.1 x 7.5	3.3 x 11.8 x 14.1	3.4 x 12.4 x 13.3	3.3 x 12.8 x 12.8	3.2 x 14 x 12	3.2 x 11.4 x 8.2	3.3 x 11.8 x 14.3	2.8 x 12.25 x 13.8	3 x 12 x 12
24.5	13.7	13.4	13.6	13.4	6.9	14.4	16.9	16.4
VGA	VGA	EGA	EGA	CGA	CGA	VGA	CGA	VGA
Gas plasma	Liquid crystal	Liquid crystal	Liquid crystal	Gas plasma	Liquid crystal	Liquid crystal	Gas plasma	Liquid crystal
640 x 480	640 x 480	640 x 400	640 x 400	640 x 400	640 x 200	640 x 480	640 x 400	640 x 480
Addonics	Sharp	Tandon	Toshiba	Toshiba	Texas Instruments	Texas Instruments	NTC	Zenith
Chips and Technologies	Sharp	Chips and Technologies	Toshiba	Toshiba	Faraday	Texas Instruments	Chips and Technologies	Chips and Technologies
Interleaved	Row/column	Page mode	Row/column	Static column	Page mode	Page mode	Interleaved, page mode	Interleaved, page mode
0	1	1	1	1	1	1	0	0
8MB	640K	1MB	1MB	1MB	1MB	1MB	8MB	1MB
8MB	640K	1MB	5MB	5MB	3MB	2MB	8MB	1MB
SIP, DIP (100 ns.)	SIP (100 ns.)	SIMM (100 ns.)	DIP (100 ns.)	DIP (85 ns.)	DIP (120 ns.)	SIMM, ZIP (120 ns.)	SIP (70, 80 ns.)	DIP (100 ns.)
1Mb	256Kb	1Mb	256Kb	1Mb	1Mb	1Mb	1Mb	1Mb
N/A	1MB	N/A	N/A	N/A	N/A	N/A	N/A	None
N/A	3MB	N/A	N/A	N/A	N/A	N/A	N/A	2MB
N/A	SIMM (100 ns.)	N/A	N/A	N/A	N/A	N/A	N/A	DIP (100 ns.)
N/A	1Mb	N/A	N/A	N/A	N/A	N/A	N/A	1Mb
AMI (September 1988)	Phoenix 3.10.03 (June 1989)	Tandon 3.31 (October 1989)	Award 1.2 (August 1989)	Award 1.70 (October 1988)	Phoenix 3.10.00 (January 1988)	Phoenix 3.10.03 (January 1988)	Phoenix 3.10.20 (January 1988)	Zenith 3.2A (1989)
☐	☐	■	☐	☐	☐	☐	☐	☐
■	☐	☐	■	☐	☐	☐	■	☐
■	☐	■	☐	☐	■	☐	■	☐
Miniscribe	Conner	Conner	JVC	Conner	Conner	Conner	Toshiba	Conner
71MB	40MB	21MB	40MB	40MB	21MB	40MB	45MB	40MB
ST-506	IDE	IDE	ST-506	IDE	ST-506	ST-506	ST-506	IDE
18	25	24	29	25	25	27	26	28
Adaptec	Conner	Conner	JVC	Conner	Conner	Conner	NTC	Conner
40MB, 66MB, 110MB ST-506; 150MB ESDI	None	None	None	None	None	20MB ST-506	None	20MB ST-506
1.44MB, 1.2MB	1.44MB	1.44MB	1.44MB	1.44MB	N/A	1.44MB	1.44MB	1.44MB
3.5-, 5 25-inch	3.5-inch	3.5-inch	3.5-inch	3.5-inch	N/A	3.5-inch	3.5-inch	3.5-inch
TEAC, Mitsumi	Sankyo	Matshita	Citizen	Toshiba	N/A	TEAC	Epson	Matsushita
8	6, 8, 12	6, 12	12	8	N/A	N/A	8	8
Two 8-bit, six 16-bit	None	One proprietary	One proprietary	One 8-bit, one proprietary	None	None	One 8-bit	One proprietary
2	N/A	1	1	1	N/A	N/A	None	1
3 half-height	2 half-height	2 half-height	2 half-height	2 half-height	1 half-height	2 half-height	2 half-height	2 half-height

CONTINUES

emulate 16 shades of gray. The 1.62 aspect ratio is acceptable for graphics with only minimal circle flattening, so if CGA and MDA video modes are enough the screen may be all you need. Even though the case is large, the viewable display area is just 7.75 by 4.87 inches.

The keyboard takes full advantage of the case width. There are 85 keys with ten function keys across the top and a numeric/cursor-control keypad combination on the right. The keys have a light, clicky feel.

In addition to the standard internal drives, there is an external floppy drive port. KISS sells four varieties of external floppy disk drives—360K and 720K floppy disk drives for \$125 each, and 1.2MB or 1.44MB drives for \$140 each.

The full-length 16-bit and 8-bit slots account for some of the case's extra size, so this compromise certainly comes with a payoff. You can slide in modem or network cards or any standard ISA expansion card without having to use an external expansion chassis or being limited to proprietary expansion cards.

The internal battery lasts up to 1 hour; KISS also sells an external lead-acid battery rated for a 2-hour life for \$125. This optional battery has its own charger unit and weighs 4.5 pounds. Unfortunately, the external battery has exposed wiring and looks like a part from a 1950s motorcycle.

KISS computers are currently sold directly by the manufacturer, although a dealer network is being planned. The warranty is a standard one-year parts-and-labor guarantee when the machine is returned to the place of purchase.

I can't recommend the KISS laptop. The reasonably nice screen notwithstanding, the weight, features, performance, and price just don't come together well enough to be competitive.

MAXTRON

Maxtron PC III 286

by John R. Quain

If you're going to drag around something weighing more than 20 pounds, reason would dictate that it had better be valuable. At nearly 24 pounds, Maxtron's 12-MHz AC-only PC III 286 falls in line with its competitors in terms of price and performance. But when it comes to expandability, you'll be tempted to leave this lunchbox in a cab.

For the \$3,398 base price, the Maxtron comes with 1MB of RAM, a 44MB hard disk, a 1.44MB 3.5-inch floppy disk drive, VGA graphics, a gas plasma display, a carrying case, and a plug. No DOS 3.3, no modem, no second floppy disk drive. Our test unit came with these options, and a higher sticker price of \$3,600. An optional \$180 car battery adapter is available from the manufacturer.

One feature that might have redeemed the cumbersome Maxtron is the VGA gas plasma display. In our opinion, however, it wasn't worth the weight either. In the PC Labs graphics tests, the machine performed competently, but only just. There was no apparent flicker in any of the graphics images, but their color mapping left much to be desired, producing 16 shades of orange that showed nearly no discernable difference. In its favor, this unit is able to run its own display and an outboard VGA monitor simultaneously—a feat duplicated by only a few others in our test group.

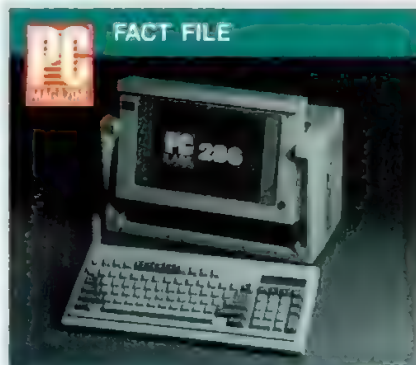
Encased in a garden-variety Compaq clone lunchbox, the carapace of the Maxtron 286 spurred the greatest criticism. The latches and catches of this clone are awkward, failing to incorporate the design elements that made the Compaq original nearly impervious to rough handling. The Maxtron also requires extra effort for such

tasks as shoving the screen back into the box, which takes two hands to lock it into place with two sliding latches located on either side.

The detachable keyboard (with 12 function keys across the top) is connected to the exterior of the machine. After a small amount of use, this hookup proved to be too tenuous to survive the rigors of travel. The cord is stowed in a compartment in the keyboard. When it is unraveled, flimsy plastic legs flip down on the underside of the keyboard; because of the design, they cannot be snapped back into place when the keyboard is connected.

In PC Labs' overall benchmark tests, the Maxtron PC III 286 performed solidly, placing it in the top third in its class. Considering its price and bulk, however, it would be reasonable to expect the Maxtron 286 to offer both topflight performance and the flexibility of Nadia Comaneci. After including expanded memory, an internal modem, and the VGA card, all the space that remained in our unit was one empty half-slot. Hardly up to Olympic standards.

Aside from the keyboard concerns, nothing is egregiously awry with the Maxtron PC III 286. On the other hand, there is nothing in particular to recommend it—and several minor complaints to dissuade one from considering it. Its real shortfall is the absence of a discernible market. Our Labs saw half a dozen machines in the same lunchbox with similar configurations. A few years ago, these features might have been worth the struggle of a nearly 24-pound lunchbox, but today a lighter 286 clamshell will give you more power for about the same price.



Maxtron PC III 286

Maxtron, 1825A Durllee Ave., South Elmont, CA 91733; (818) 350-5707.

List Price: With 1MB RAM, 44MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA gas plasma display, one parallel, one serial port, carrying case, \$3,398; with DOS 3.3, \$3,493; with internal 2,400-bps modem, 1.22MB 5.25-inch floppy disk drive, \$3,600.

In Short: A 12-MHz AC-only 24-pound Compaq clone similar to several others in this roundup, the Maxtron PC III 286 performs competently but fails to offer enough expandability to justify its hefty weight.

CIRCLE 607 ON READER SERVICE CARD

MICRO EXPRESS

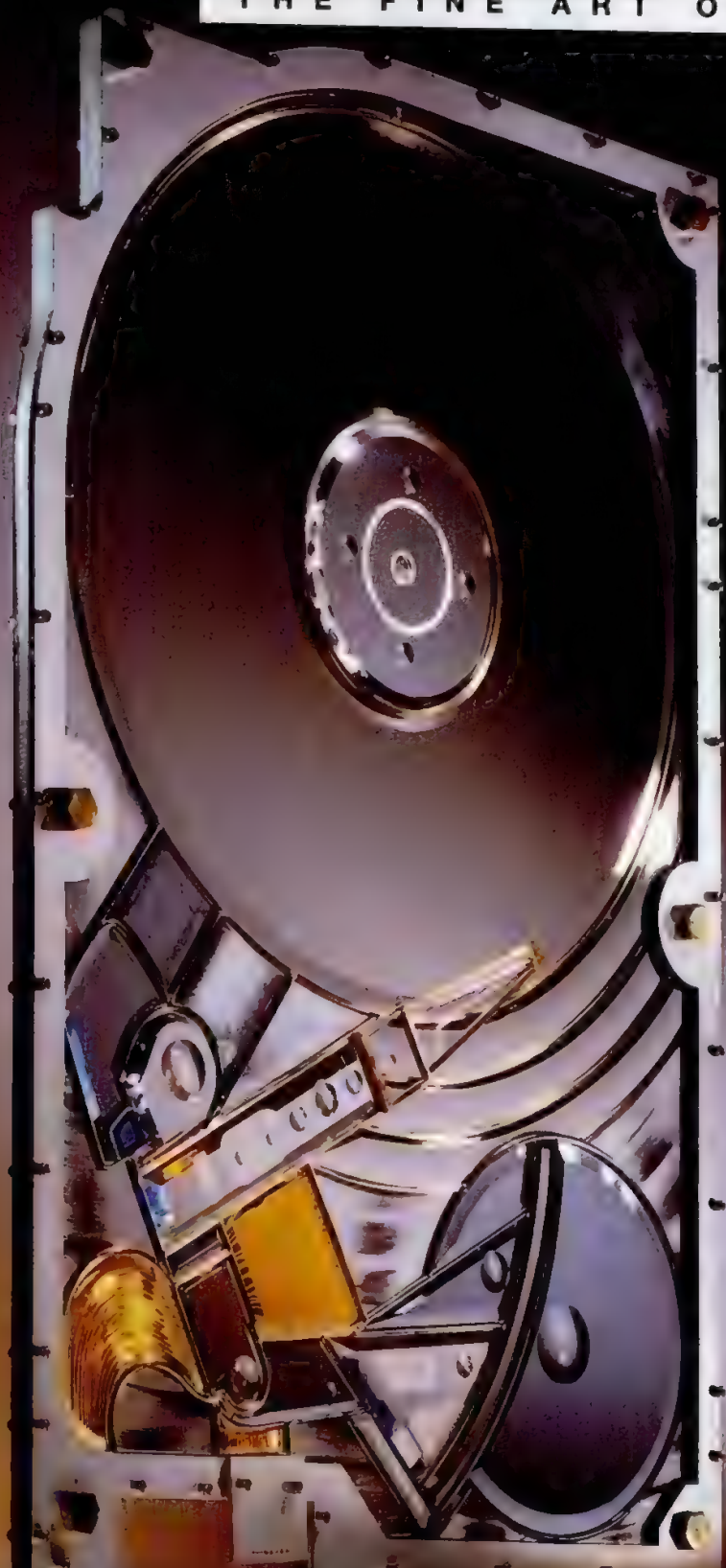
Micro Express Lyte-Byte 3400

by Bruce Brown

If you want a good deal on a fast laptop but don't need battery operation, take a close look at the Micro Express Lyte-Byte 3400. This easily expandable machine weighs almost 17 pounds when fully equipped, but a list of the features you get makes the weight easier to bear.

The test machine included 5MB RAM, a 100MB hard disk, 1.44MB floppy disk drive, EGA gas plasma display, one parallel and two serial ports, a 10-MHz 80287

THE FINE ART OF DISC DRIVES



Beveled Glass Window by
Thomas Tisch & Andreas Lehmann
Oakland, California

Even to the experienced observer, a disc drive is a technological marvel. With discs spinning at 60 revolutions per second, the mechanics involved are astounding. It takes a company with a unique level of skill and experience to produce drives in volume that perform reliably year after year. A company like Seagate.

Our 3.5" ST1096 family is a great example of Seagate craftsmanship. Featuring a choice of 42, 60 or 83 formatted megabytes, these high performance (24 msec average access time) drives are ready for demanding PC and Apple® applications. The family offers ST412/MFM and SCSI interfaces for application flexibility. And they all feature a 50,000 hour mean-time-between-failure rate.

Like the artist who spends years perfecting his craft, Seagate has spent the past decade mastering the fine art of disc drives. For more information on our multi-faceted product line, contact your authorized Seagate distributor, or call Seagate directly at 800-468-DISC, or 408-438-6550.

 **Seagate**

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286-BASED PORTABLES: SUMMARY OF FEATURES

	Altima One	Blue Max Attache 286	Bondwell B310	CD Technology Portable	Compaq LTE/286	Compaq Portable III	Compaq SLT/286	Data World Portacomp II 286-16
VIDEO								
Display circuitry location	Motherboard	Card	Motherboard	Card	Motherboard	Motherboard	Motherboard	Card
Interface	8-bit	8-bit	8-bit	8-bit	8-bit	8-bit	16-bit	16-bit
Chip set manufacturer	Sanpo	Paradise	Bondwell	Western Digital	Compaq	Compaq	Compaq	Chicony
Video modes supported	CGA, MDA	HGC, CGA, MDA	CGA, MDA	VGA, EGA, CGA, MDA	CGA, MDA	CGA, MDA	VGA, EGA, CGA, MDA	EGA, CGA, MDA
Viewable area (WxH, in inches)	8.25 x 5.25	7 x 5.75	8.75 x 3.75	8.3 x 5.1	7.7 x 3.7	8.3 x 5.2	7.8 x 4.9	8.25 x 5.5
Supports internal and external displays simultaneously	✓	■	✓	■	✓	✓	✓	■
KEYBOARD								
Number of keys	101	84	81	86	81	91	82	102
Number of function keys	12	10	10	12	10	12	12	12
Keyboard cable length (inches)	24	20	N/A	18	N/A	24	24	35
SOFTWARE AVAILABLE								
OS/2	None	None	None	None	1.1 (\$340)	1.1 (\$340)	1.2 (\$340)	1.1 (\$325)
Disk caching software	✓	■	✓	✓	■	■	■	✓
Expanded memory manager	■	■	✓	✓	■	■	■	✓
PHYSICAL FEATURES								
Power supply (watts)	100	150	27	180	14.75	145	18	150
Switchable power supply	■	■	■	■	■	■	■	■
Number of device connectors	N/A	4	N/A	3	N/A	2	2	4
Keyboard lock	None	Side	None	None	None	None	None	None
Case lock	None	None	None	None	None	None	None	None
Power-on switch	Side	Side	Side	Back	Front	Back	Side	Back
Reset button	Side	Side	None	Front	None	None	None	Side
BATTERY								
Battery type	External	N/A	Internal	N/A	Removable	N/A	Removable	N/A
Battery material	Nickel cadmium	N/A	Nickel cadmium	N/A	Nickel cadmium	N/A	Nickel cadmium	N/A
Claimed battery life	2 hours	N/A	3 hours	N/A	3.5 hours	N/A	3 hours	N/A
Battery charge time	1.5 hours	N/A	8 hours	N/A	8-10 hours	N/A	1.5 hours	N/A
Battery voltage and Amp/hours	10V, 1.5Ah	N/A	7.2V, 1.8Ah	N/A	4.8V, 5Ah	N/A	12V, 2.4Ah	N/A
Battery conservation techniques	None	N/A	Display and disk shutdown	N/A	Display, disk, and processor shutdown	N/A	Display, disk, and modem shutdown	N/A
Transformer weight (lbs.)	Built-in	N/A	1.86	N/A	1.40	N/A	1.79	N/A
Transformer size (inches)	Built-in	N/A	2.1 x 3.5 x 2.1	N/A	3.1 x 5.1 x 2.1	N/A	3.3 x 8.5 x 2.3	N/A
Car battery adapter available	■	✓	✓	✓	■	✓	✓	✓
Options								
External floppy disk drives	■	✓	✓	✓	■	✓	■	■
Capacity	360K, 1.2MB	N/A	N/A	N/A	1.44MB: 360K, 1.2MB	N/A	1.2MB	1.2MB
Size	5.25-inch	N/A	N/A	N/A	3.5-, 5.25-inch	N/A	5.25-inch	5.25-inch
Modems (bits per second)	2,400	2,400, 9,600	2,400	None	2,400	1,200, 2,400	2,400	None
Error correction	None	MNP Level 5	MNP Level 5	N/A	None	None	None	N/A
Expansion chassis	✓	✓	✓	✓	✓	■	✓	✓
Bus speed (MHz)	N/A	N/A	N/A	N/A	N/A	8	N/A	N/A
Expansion slots	N/A	N/A	N/A	N/A	N/A	Two 16-bit	N/A	N/A
Docking station	✓	✓	✓	✓	✓	✓	■	✓
Bus speed (MHz)	N/A	N/A	N/A	N/A	N/A	N/A	8	N/A
Expansion slots	N/A	N/A	N/A	N/A	N/A	N/A	Two 16-bit	N/A

■—Editor's Choice ■—Yes ✓—No

N/A—Not applicable; the product does not have this feature

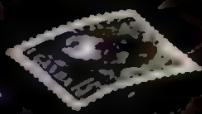
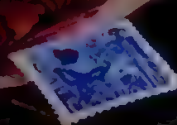
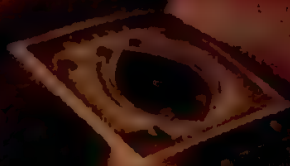
PORTABLES 286-BASED

Dauphin LapPRO-286	Dolch P.A.C. 286-12	Dolch P.A.C. 286-16	Dynabook 286	Epson Equity LT-286e	GRIDCase 1520	Hyundai Super-LT3	KISS TL-3240EL	LapPower 286/20	Maxtron PC III 286
Motherboard 16-bit Dauphin	Card 8-bit Dolch	Card 8-bit Dolch	Motherboard 16-bit Cirrus Logic	Motherboard 16-bit Yamaha	Motherboard 8-bit Cirrus Logic	Motherboard 8-bit Gemini	Motherboard 8-bit KISS	Card 8-bit Vendata	Card 16-bit Signal
CGA, MDA 8.8 x 5.5 □	CGA, MDA 7.75 x 5 □	CGA, MDA 7.75 x 5 □	VGA, EGA, CGA, MDA 8.9 x 6.6 □	EGA, CGA, MDA 8.25 x 6.25 □	VGA, EGA, CGA, MDA 8.25 x 6.25 □	CGA, MDA 9.4 x 4.4 ■	CGA, MDA 7.75 x 4.9 □	VGA, EGA, CGA, MDA 8 x 6.5 □	VGA, EGA, CGA, MDA 8.25 x 5.25 ■
75	88	86	85	84	72	77	85	86	84
12	12	12	12	10	12	10	10	12	12
N/A	24	24	N/A	N/A	N/A	N/A	N/A	30	8
None □ □	None □ □	None □ □	None □ ■	None □ ■	None □ □	None □ □	None □ ■	None □ ■	None □ □
38	200	200	33	42.5	60	30	Info not available	63	200
■	□	■	■	■	■	■	■	■	■
N/A	2	2	N/A	N/A	N/A	N/A	N/A	N/A	2
None	None	None	None	None	None	None	None	None	None
None	None	None	None	None	None	None	None	Side	None
Back	Back	Back	Back	Side	Back	Side	Back	Side	Back
None	Front	Front	None	Side	None	Side	None	None	Front
Removable Lead acid 1.5 hours 8 hours 12V, 2.4Ah Display shutdown	N/A N/A N/A N/A N/A	N/A N/A N/A N/A N/A	Removable Lead acid 2-4 hours 12 hours 5V, 10Ah Display, disk, modem, and processor shutdown	Removable Nickel cadmium Up to 3 hours 8 hours 9.6V, 4Ah Display and disk shutdown	Removable Nickel cadmium 0.5-1.5 hours 8-10 hours 10.8V, 1.7Ah Display and disk shut-down	Removable Nickel cadmium 3 hours 8 hours 4.8V, 5Ah Display and disk shut-down	Internal Lead acid 1 hour 6 hours 12V, 3.6Ah None	Removable Nickel cadmium 2 hours 2-3 hours 12V, 2.4Ah Display and disk shut-down	N/A N/A N/A N/A N/A
Built-in Built-in ■	N/A N/A □	N/A N/A □	1.97 2.9 x 6.1 x 1.9 □	2.82 4.8 x 8.0 x 2.5 □	0.91 7 x 11.4 x 1.5 ■	1.9 3.5 x 8 x 2.25 □	N/A N/A □	1.08 3 x 7.5 x 2.5 □	N/A N/A □
■	□	□	□	■	■	■	■	■	■
360K, 1.2MB 5.25-inch 2,400, 4,800 MNP Level 4, 5	N/A N/A 2,400 None	N/A N/A 2,400 N/A	N/A N/A 2,400 None	1.2MB 5.25-inch 2,400 None	1.44MB, 1.2MB 3.5-, 5.25-inch 2,400 N/A	360K, 1.2MB 5.25-inch 1,200, 2,400 None	1.44MB, 1.2MB 3.5-, 5.25-inch None N/A	1.44MB, 1.2MB 3.5-, 5.25-inch 2,400 None	360K, 1.2MB; 760K, 1.44MB 3.5-, 5.25-inch 2,400 None
■	■	■	□	□	■	□	□	■	■
12 One 16-bit	6, 12 Six 16-bit	8, 16 Six 16-bit	N/A N/A	N/A N/A	10 Six 8-bit	N/A N/A	N/A N/A	8 One 8-bit, two 16-bit	N/A N/A
□	□	□	□	□	□	□	□	□	□
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

CONTINUES



TOSHIBA



Introducing the first notebook PC that doesn't leave room for compromise.

The T1000SE isn't just the smallest, lightest portable computer we've ever made. It's also the most uncompromising notebook PC ever created.



The 144MB 3.5-inch diskette drive is an industry standard.

Unlike most notebooks, the T1000SE has a built in 144MB 3.5-inch diskette drive, the industry-standard media that ensures compatibility with existing systems.

And unlike most notebooks, the T1000SE's function hasn't been sacrificed to form. There's a full-size 82-key ergonomically-sculptured keyboard with standard layout.

And to help you work even more efficiently, we've incorporated a 640x400 supertwist backlit screen. Its doublescan CGA design offers uncompromising resolution.



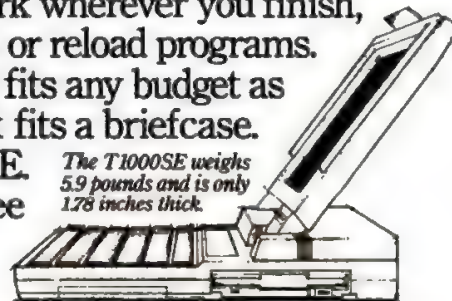
Ergonomically sculptured keyboard with a look and feel you're already familiar with.

Another standard feature is our AutoResume, which lets you restart your work wherever you finish,

eliminating the need to reboot or reload programs.

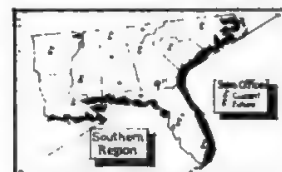
Then there's the price. It fits any budget as nicely as our notebook fits a briefcase.

The T1000SE.
Take it. See
how far
you can go.



The T1000SE weighs 5.9 pounds and is only 1.78 inches thick.

The Toshiba T1000SE: Battery-operated 80C86/95MHz, 144MB 3 1/2" diskette drive, 1MB RAM expandable to 3MB, backlit LCD, removable rechargeable battery pack, AutoResume, dual-function port for parallel printer or external 5 1/4" FDD, RS-232C serial port, dedicated modem slot. For more information call 1-800-457-7777.



Large, easy-to-read 640x400 pixel high-resolution screen.

In Touch with Tomorrow
TOSHIBA

Toshiba America Information Systems Inc., Computer Systems Division

CIRCLE 390 ON READER SERVICE CARD

PORTABLES 286-BASED



286-BASED PORTABLES: SUMMARY OF FEATURES

	Micro Express Lyte-Byte 3400	Micro Express Regal 286	Mitsuba Ninja-12 VGA	Mitsubishi MP 286L/240EVP	NEC PowerMate Portable Plus	NEC ProSpeed 286	Packard Bell PB286LP	PC Brand Portable PC III 286/12
VIDEO								
Display circuitry location	Card	Card	Motherboard	Card	Motherboard	Card	Motherboard	Card
Interface	16-bit	8-bit	8-bit	8-bit	16-bit	16-bit	8-bit	16-bit
Chip set manufacturer	Gemini	Gemini	Chips and Technologies	Mitsubishi	Paradise	Chips and Technologies	Packard Bell	PC Brand
Video modes supported	EGA, CGA, MDA	EGA, CGA, MDA	VGA, EGA, CGA, MDA	EGA, CGA, MDA	VGA, EGA, CGA, MDA	VGA, EGA, CGA, MDA	CGA, MDA	VGA, EGA, CGA, MDA
Viewable area (WxH, in inches)	8.25 x 5.25	8.25 x 5.25	7.9 x 6	9 x 6.5	7.5 x 4.8	7.6 x 5.6	8.3 x 5.1	8.0 x 6.5
Supports internal and external displays simultaneously	■	□	□	□	■	■	□	■
KEYBOARD								
Number of keys	85	102	82	86	93	83	82	86
Number of function keys	10	12	10	12	12	12	10	12
Keyboard cable length (inches)	N/A	24	N/A	N/A	58	N/A	N/A	18
SOFTWARE AVAILABLE								
OS/2	None	1.1 (\$275)	None	None	1.0 (\$325)	1.0 (\$325)	None	None
Disk caching software	□	□	□	■	■	■	□	□
Expanded memory manager	□	■	■	■	■	■	□	■
PHYSICAL FEATURES								
Power supply (watts)	100	180	78	54	80	50	55	200
Switchable power supply	■	■	■	■	■	■	■	■
Number of device connectors	N/A	2	N/A	N/A	2	N/A	N/A	4
Keyboard lock	None	None	None	None	None	None	None	None
Case lock	None	None	Side	None	None	None	None	None
Power-on switch	Side	Front	Side	Side	Side	Back	Side	Back
Reset button	Front	Side	None	Front	Side	Back	Back	Front
BATTERY								
Battery type	N/A	N/A	Internal	N/A	N/A	Removable	Removable	N/A
Battery material	N/A	N/A	Nickel cadmium	N/A	N/A	Nickel cadmium	Nickel cadmium	N/A
Claimed battery life	N/A	N/A	3 hours	N/A	N/A	3 hours	3 hours	N/A
Battery charge time	N/A	N/A	5 hours	N/A	N/A	3.5 hours	3-6 hours	N/A
Battery voltage and Amp/hours	N/A	N/A	1.2V, 4Ah	N/A	N/A	12V, 1.2Ah	12V, 4Ah	N/A
Battery conservation techniques	N/A	N/A	Display and disk shut-down	N/A	N/A	Display and disk shut-down	Display and disk shut-down	N/A
Transformer weight (lbs.)	N/A	N/A	1.5	N/A	N/A	1	1.57	N/A
Transformer size (inches)	N/A	N/A	6.5 x 3 x 2	N/A	N/A	5.4 x 4.5 x 1.6	3 x 6.5 x 2.3	N/A
Car battery adapter available	□	□	■	□	□	■	□	□
OPTIONS								
External floppy disk drives	■	■	■	■	■	■	□	□
Capacity	1.2MB	1.2MB	1.2MB	1.2MB	1.2MB	1.2MB	N/A	N/A
Size	5.25-inch	5.25-inch	5.25-inch	5.25-inch	5.25-inch	5.25-inch	N/A	N/A
Modems (bits per second)	2,400	1,200, 2,400	2,400	2,400	1,200, 2,400	2,400	2,400	1,200, 2,400
Error correction	None	None	None	None	MNP Level 5	None	None	None
Expansion chassis	□	□	□	□	□	■	□	□
Bus speed (MHz)	N/A	N/A	N/A	N/A	N/A	8	N/A	N/A
Expansion slots	N/A	N/A	N/A	N/A	N/A	One 8-bit, three 16-bit	N/A	N/A
Docking station	□	□	□	□	□	□	□	□
Bus speed (MHz)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Expansion slots	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

□—Editor's Choice ■—Yes □—No

N/A—Not applicable: the product does not have this feature

PORTABLES

286-BASED

PC Brand Portable PC III 286/20	Sharp PC-5541	Tandon LT/286	Toshiba T1600/40	Toshiba T3100e/40	TravelMate LT286 Model 12	TravelMate LT286 Models 25 and 45	UNIQ/PhD Laptop 286-12	Zenith SupersPort 286e
Card	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard
16-bit	16-bit	8-bit	16-bit	8-bit	16-bit	16-bit	8-bit	16-bit
ATIS	Chips and Technologies	Chips and Technologies	Toshiba	Toshiba	Chips and Technologies	Chips and Technologies	Yamaha	Zenith
VGA, EGA, CGA, MDA	VGA, EGA, CGA, MDA	EGA, CGA, MDA	EGA, CGA, MDA	CGA, MDA	CGA	VGA, EGA, CGA, MDA	CGA, MDA	VGA, EGA, CGA, MDA
8.0 x 6.5	7.75 x 5.75	9 x 5.7	9 x 5.7	7.75 x 14.75	8.75 x 3.8	7.8 x 5.87	8.4 x 5.4	8 x 6
■	□	□	□	□	□	□	□	□
86	79	82	86	82	84	79	81	79
12	12	12	12	10	12	10	10	12
18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
None	None	None	1.1 (\$325)	1.0 (\$325)	None	None	None	1.1 (\$339)
┐	□	□	■	■	□	□	□	■
└	■	□	□	■	□	□	□	■
200	26.4	45	18	180	25	23	120	30
■	■	■	■	■	□	□	■	■
4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
None	None	None	None	None	None	None	None	None
None	None	None	None	None	None	None	None	None
Back	Side	Back	Back	Back	Side	Back	Back	Side
Front	None	None	None	None	None	None	None	None
N/A	Removable	Removable	Removable	N/A	Removable	Removable	N/A	Removable
N/A	Nickel cadmium	Nickel cadmium	Nickel cadmium	N/A	Nickel cadmium	Nickel cadmium	N/A	Nickel cadmium
N/A	2 hours	3 hours	2-3 hours	N/A	2-3 hours	2-3 hours	N/A	4 hours
N/A	4 hours	14 hours	8 hours	N/A	6-8 hours	8 hours	N/A	8-12 hours
N/A	12V, 2.2Ah	12V, 2.4Ah	9.6V, 2Ah	N/A	9.6V, 1.6Ah	12V, 2.5Ah	N/A	12V, 4Ah
N/A	Display, disk, and modem shutdown	Display and disk shut-down	Display and disk shut-down, resume feature	N/A	Display, disk, and processor shutdown	Display, disk, and processor shutdown	N/A	Display and disk shut-down
N/A	1.69	1.59	1.21	N/A	1.17	1.87	N/A	1.65
N/A	3.4 x 6.9 x 2.3	3.1 x 6.5 x 2.1	3 x 8.5 x 2	N/A	2.4 x 1.9 x 3.4	3.4 x 6.9 x 2.5	N/A	3 x 6.5 x 2
□	□	□	□	□	■	□	□	■
□	□	■	■	■	■	□	■	■
N/A	N/A	1.2MB	360K	360K	1.44MB	N/A	1.2MB	1.2MB
N/A	N/A	5.25-inch	5.25-inch	5.25-inch	3.5-inch	N/A	5.25-inch	5.25-inch
1,200, 2,400	1,200, 2,400	None	2,400	2,400	2,400	2,400	2,400	2,400
None	None	N/A	None	None	None	None	None	None
□	□	■	■	■	□	□	□	■
N/A	N/A	8 MHz	8	4.66, 8	N/A	N/A	N/A	8
N/A	N/A	Three 16-bit	Five 8-bit	Five 8-bit	N/A	N/A	N/A	Three 8-bit
□	□	□	□	□	□	□	□	□
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

CONTINUES

PORTABLES

286-BASED

math coprocessor, and a carrying case—all for a total of \$4,215. The base unit costs only \$2,495 with just 1MB RAM and a 20MB hard disk, but without a math coprocessor or DOS.

Not only do you get a lot for your money, but you also get better-than-usual 286 performance because the processor in the Lyte-Byte 3400 is a Harris 16-MHz 80C286, which scores about as fast as a 16-MHz 386 on typical DOS tasks. The motherboard, as well as many of the machine's components, are manufactured by Chicony and packaged by Micro Express with other pieces, including AMI ROM BIOS chips.

The dark-gray-cased Lyte-Byte has a full-width handle and measures 3.7 by 14.8 by 13.4 inches (HWD). There are plenty of convenient compartment covers that open to expose ports and to access the single half-length 16-bit card slot. There are two 16-bit slots, but one is used by the Gemini 8-bit EGA video display adapter card.

The orange-on-black EGA gas plasma display has good contrast and an aspect ratio of 1.54, with slightly flattened circular graphics. The resolution and screen performance on the comparison programs were as good as or better than the display in the Tangent portable used as a reference point. A 9-pin port for an external EGA monitor is standard.

The Lyte-Byte's keyboard has 85 keys,

with 10 function keys across the top and a separate numeric keypad. The keyboard's spacing and feel are both fine. There's also an external keyboard port. One unique feature is the pair of slide latches that when pushed allow you to lift the keyboard out of the computer for access to the Lyte-Byte's innards, where you find memory chips, coprocessor slot, and drives. Since you probably won't be opening up the machine very much, if ever, this feature has limited utility but is a nice design touch.

Micro Express sells computers only by mail order. The Lyte-Byte 3400 comes with a 15-month parts-and-labor warranty and a 30-day money-back guarantee. If you need service during the warranty, you can use either the toll-free technical support number with 24-hour Federal Express delivery of identified defective components, or you can send the whole computer to Micro Express, with return shipment paid by Micro Express.

The Lyte-Byte 3400's nicely compartmented case, 16-MHz performance, and very aggressive pricing are three compelling reasons to look closely if you want portable AC-powered computing with lots of functionality.

MICRO EXPRESS

Micro Express
Regal 286

by Bruce Brown

How to stuff a lunchbox: start with a Chicony lunchbox case, include a 20-MHz Harris 80C286 processor for 386-like performance, put in 4MB of 80-nanosecond RAM, a 177MB 15-millisecond hard disk drive, and a 10-MHz 80287 math coprocessor. Slap a \$3,819 price tag on this configuration—which also includes MS-DOS 3.3, an EGA gas plasma display, one serial and one parallel port, and a 1.44MB 3.5-inch floppy disk drive—and then wait for the phones to start ringing. That's exactly what Micro Express has done with the Regal 286.

So you want a cheaper lunch? Micro Express sells the same basic unit with just 1MB of RAM and a 20MB hard drive for \$2,074.

The Regal 286 is an AC-only computer with an InformTech motherboard and Award ROM BIOS chip set. As you can



Micro Express Regal 286

Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; (800) Micro-21, (714) 852-1400.
List Price: With 1MB RAM, 20MB hard disk, one 1.44MB 3.5-inch floppy disk drive, EGA gas plasma display, one serial and one parallel port, DOS 3.3, \$2,074; with 4MB RAM, 177MB hard disk, external 1.2MB 5.25-inch floppy disk drive, 10-MHz 80287 math coprocessor, MS-DOS 3.3, \$3,819.

In Short: A successful exercise in how much you can stuff into a standard lunchbox case, including a humongous hard disk drive and a 20-MHz processor, at a truly affordable price.

CIRCLE 601 ON READER SERVICE CARD

see from its benchmark test scores, the 20-MHz Harris processor chip delivers performance similar to 20-MHz 386s on many tests. Although you can install only 4MB RAM on the motherboard using 1-megabit DIP DRAM chips, you can expand up to 16MB using third-party expansion cards in one of the two available expansion slots.

The power supply uses one 8-bit and two 16-bit slots on the motherboard, but there are still two 8-bit and three 16-bit slots available, with one slot of each type free after you add video, drive controller, and I/O cards.

From the outside, the Regal 286 looks like most other lunchbox computers. Its 9.75- by 16- by 8.25-inch (HWD) size and 23-pound weight (as tested) are typical. There is a padded handle on top, but if you're going to carry it any distance longer than downstairs to your car, you'll probably want to employ the standard nylon carrying case.

The 640 by 400 resolution EGA- and CGA-compatible display is the standard unit that comes with this case, with a 1.62 aspect ratio capable of displaying 16 shades of gray. Subjectively, the graphics display performance is similar to that of the Tangent machine we used to compare EGA displays.

There is room for only two 3.5-inch drives inside the computer's case, but you'll find an external floppy disk drive



Micro Express Lyte-Byte 3400

Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; (800) Micro-21, (714) 852-1400.
List Price: With 1MB RAM, 40MB hard disk, 1.44MB 3.5-inch floppy disk drive, EGA gas plasma display, one parallel and two serial ports, carrying case, \$2,495; with DOS, 5MB RAM, 100MB hard disk, external 1.2MB 5.25-inch floppy disk drive, 10-MHz 80287 math coprocessor, \$4,215.

In Short: If you don't need battery operation and want an easy-to-carry laptop with good expansion capability, a good screen, and a great price, pay close attention to the Lyte-Byte.

CIRCLE 590 ON READER SERVICE CARD

When Edison realized that genius is "1% inspiration and 99% perspiration," he was probably trying to create graphics with a standard issue, clunky mouse.

Finally, here's a solution that'll help you create, not hinder you.

It's WIZ[™] by CalComp. A new mouse that's so different, we hesitate to even call it one. Because it combines all the easy-to-use features of a mouse and stylus with the

power of an "intelligent" graphics pad to enhance every pointing, tracing and drawing function you do.

When you draw with the WIZ mouse and optional pen, it feels just like drawing with a marker. In fact, you'll discover that you can be just as detailed and precise. Perhaps even more expressive and creative.

What's more, WIZ unleashes the creativity and speed of both you and your

software with optional templates for the pad. Because WIZ templates put the commands at your fingertips for instant access.

And for under \$200, getting WIZ is no sweat. Just see your nearest computer dealer* or call 800-458-5888 for more inspiration (or information, if you prefer).

WIZ by CalComp. Everything else is just a mouse.



Perspiration.



Inspiration.



*WIZ is distributed by Ingram Micro, Inc. Your local dealer can order WIZ by calling 800-458-5888. © CalComp Inc. WIZ is a trademark of CalComp. All product names and logos are trademarks of their respective owners.

CIRCLE 144 ON READER SERVICE CARD

PORTABLES

286-BASED



286-BASED PORTABLES: SUMMARY OF FEATURES

	Altima One	Blue Max Attache 286	Bondwell B310	CD Technology Portable	Compaq LTE/286	Compaq Portable III	Compaq SLT/286	Data World Portacom II 286-16
CONNECTIVITY								
Topology of available network cards	None	None	None	None	None	None	None	Ethernet
Third-party network cards available	☐	☐	☐	☐	☐	☐	☐	☒
MISCELLANEOUS								
Coprocessor supported	80287-8	80287-12, 80387SX-16	None	80287-10	80287-12	80287-8	80287-12	80287-10
Distribution (dealer or direct)	Direct	Both	Dealer	Both	Dealer	Dealer	Dealer	Direct
Warranty	1 year	1 year	1 year	90 days	1 year	1 year	1 year	1 year
Service	Ship to manufacturer	Ship to manufacturer	Return to dealer	Ship to manufacturer or return to dealer	Return to dealer	Return to dealer	Return to dealer	Ship to manufacturer
FCC certification	B	A	B	A	B	B	B	A
☒ —Editor's Choice ☒ —Yes ☐ —No								

port on the back of the machine. A 1.2MB external floppy disk drive is an inexpensive \$120 option.

The Regal 286 comes standard with a 15-month parts-and-labor warranty that includes four months of on-site service by Nationwide Warranty. Micro Express sells its merchandise through mail order and includes a 30-day money-back guarantee with all machines.

If a 20-MHz processor, a huge hard disk, and excellent expansion capabilities at a competition-busting price are magic buttons for you, Micro Express has your number.

MITSUBA CORP.

Mitsuba Ninja-12
VGA

by John R. Quain

By adding VGA graphics to the weaponry of its competitively priced Ninja-12 clamshell, Mitsuba appears to be sneaking up on the 286 laptop market. It may not impress you with lightning speed, but at a list price of just under \$3,600, the 12-MHz Ninja will give you a very capable LCD

VGA screen, a well-tempered keyboard, and enough flexibility to complete most of your work on the road.

With the Ninja-12 VGA, you get 1MB of RAM (upgradable to 5MB), a high-density 1.44MB 3.5-inch floppy disk drive, a 40MB hard disk, ports for an external 1.2MB 5.25-inch floppy disk drive, a VGA monitor, and an external numeric keypad (\$75)—as well as an additional serial and parallel port. Also included in the package are DOS 3.3 and *Top Brass* (an executive organizer). Manufacturer's options include a \$230 internal 2,400-bit-per-second Hayes-compatible modem and a



286-BASED PORTABLES: SUMMARY OF FEATURES

	Micro Express Lyte-Byte 3400	Micro Express Regal 286	Mitsuba Ninja-12 VGA	Mitsubishi MP 286L/240EVP	NEC PowerMate Portable Plus	NEC ProSpeed 286	Packard Bell PB286LP	PC Brand Portable PC III 286/12
CONNECTIVITY								
Topology of available network cards	None	None	None	Arctnet, Ethernet	None	EtherNet, StarLAN	None	Arctnet, Ethernet
Third-party network cards available	☒	☒	☒	☐	☒	☒	☐	☐
MISCELLANEOUS								
Coprocessor supported	80287-10	80287-10	None	80287-8	80287-12	80287-12	80287-8	80287-10
Distribution (dealer or direct)	Direct	Direct	Dealer	Dealer	Dealer	Dealer	Dealer	Direct
Warranty	15 months	15 months	1 year	1 year	1 year	1 year	1 year	5 years
Service	Ship to manufacturer	Return to dealer	Ship to manufacturer or return to dealer	Ship to manufacturer	Ship to manufacturer or return to dealer	Ship to manufacturer or return to dealer	Ship to third-party repair center	On-site
FCC certification	B	B	B	B	B	B	B	A
☒ —Editor's Choice ☒ —Yes ☐ —No								

PORTABLES

286-BASED

Dauphin LapPRO-286	Dolch P.A.C. 286-12	Dolch P.A.C. 286-16	 Dynabook 286	Epson Equity LT-286e	GRiDCase 1520	Hyundai Super-LT3	KISS TL-3240EL	LapPower 286/20	Maxtron PC III 286
None	None	None	None	None	Ethernet	None	Arcnet, Ethernet, Token-Ring	None	None
■	■	■	■	■	□	□	■	□	■
80287-10	80287-10	80287-10	80287-10, 80287-12	80287-8	None	80287-10	80287-12	80287-12	80287-10
Both	Both	Both	Dealer	Dealer	Direct	Dealer	Both	Dealer	Dealer
1 year	1 year	1 year	1 year	1 year	1 year	18 months	1 year	1 year	1 year
Ship to manufacturer	Ship to manufacturer	Ship to manufacturer	Return to dealer	Return to dealer	Ship to manufacturer	Return to dealer	Ship to manufacturer or return to dealer	Return to dealer	Ship to manufacturer
B	A	A	B	B	A	B	B	A	A

CONTINUES

\$95 carrying case that can accommodate the AC adapter and the optional 5.25-inch floppy disk drive.

Mitsuba has boosted its backlit black-and-white 640 by 480 CFFT (cold cathode fluorescent tube) LCD display with VGA graphics. However, on color bar tests of the machine's 16-shade gray scale, images appeared streaky and, due to the display's particular mapping, exhibited some jitter. (According to the manufacturer, the streaky problem has been resolved on the production line.) All these are shortcomings, but we felt that they were easily counterbalanced by the Ninja-12 VGA's

adroit handling of PC Labs graphics tests.

One of the most demanding graphics images—the redoubtable mandril test—was easily replicated by the Ninja-12 VGA. On many machines in this roundup, the image was unrecognizable. The Ninja's sharp, clear graphics ranked up there with higher-priced competitors from Toshiba, IBM, and Compaq.

The disappointment came—as it inevitably does—with moving RIX images. Here, the Ninja bowed to the competition by demonstrating LCD lethargy, slowing bouncing logos down to a shifting crawl. We attempted to compensate for this

weakness by changing the setup. In so doing, we regained some speed but at a significant trade-off in VGA graphics clarity. (The BIOS and video shadowing are linked together.) So your decision on whether or not the Ninja successfully liquidates the competitors in this area will depend largely on what you want to accomplish with VGA graphics.

In adjusting the Ninja's system parameters, we found the setup changes to be both mercifully quick and straightforward. The Ctrl-Alt-Esc combination calls up the convenient ROM-resident setup menu, allowing you to make alterations on the fly.

PC Brand Portable PC III 286/20	Sharp PC-5541	Tandon LT/286	Toshiba T1600/40	Toshiba T3100e/40	TravelMate LT286 Model 12	TravelMate LT286 Models 25 and 45	UNIQ/PhD Laptop 286-12	Zenith SupersPort 286e
Arcnet, Ethernet	None	None	Ethernet	Ethernet	None	None	None	None
□	□	□	■	■	□	□	□	□
80287-10	80287-8	80287-10	None	None	80287-12	80287-12	None	80287-10, 80287-12
Direct	Dealer	Dealer	Dealer	Dealer	Dealer	Dealer	Both	Dealer
5 years	1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year
On-site	Return to dealer	Return to dealer	Ship to manufacturer or return to dealer	Ship to manufacturer or return to dealer	Return to dealer	Return to dealer	Return to dealer	Return to dealer
A	B	B	B	B	B	B	B	B

ENDS

You should find the Ninja's 82-key keyboard responsive and quiet; no annoying clicks will keep the passenger next to you on the red-eye flight awake. It offers separate cursor keys and a complement of ten function keys across the top, with two additional function keys embedded. Fumbling for the backslash key was not one of our fondest memories, but, if it drives you to distraction, a mini-connector on the side allows you to connect a full AT keyboard.

The Ninja derives its power from an internal nickel cadmium battery, which in our benchmark tests lasted an acceptable length of time—45 minutes. An optional replacement battery is available for \$150, but it will increase the poundage of your load.

Unfortunately, the Ninja doesn't provide any way for you to gauge how much power you've got left before the warning beep tells you to finish that report in the next 5 to 7 minutes. But the Ninja does offer some helpful power-saving options in setup, enabling you to set hard drive powerdown at 1 to 15 minutes and display blank at 1 to 5 minutes.

Weighing in at just over 18 pounds with the adapter, the Ninja-12 VGA consistently performed a little better than average for its class. It may not have the stealth and speed of some of the more expensive clamshells out there, but the Mitsuba Ninja-12 VGA certainly has all the right moves to get the job done.



Mitsuba Ninja-12 VGA

Mitsuba Corp., 650 Terrace Dr., San Dimas, CA 91773; (800) MIT-SUBA, (714) 592-2866.
List Price: With 1MB RAM, 40MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA liquid crystal display, one parallel, two serial ports, DOS 3.3, Top Brass software, \$3,595.

In Short: An excellent LCD VGA display (with a touch of flicker), good keyboard, 40MB hard drive, and easily accessed setup in BIOS all for a price nearly \$2,000 under that of comparable name-brand VGA clamshells.

CIRCLE 602 ON READER SERVICE CARD

MITSUBISHI ELECTRONICS AMERICA INC.

Mitsubishi MP 286L/240EVP

by Fredric Burke

Mitsubishi's entry into the hotly contested 286 laptop market, the MP 286L, should not be lightly dismissed. At \$4,795 fully loaded, the AC-powered system boasts a fast hard disk, decent screen, an above-average keyboard, and great software.

The clamshell MP 286L comes in several guises: 210, 220, 220VP, 240, and the 240EVP, the model tested. All feature the same 11-inch diagonal screen, 1.44MB floppy disk drive, enclosed in a 3.5- by 12.3- by 14-inch (HWD) sleek black case. While the 220 and the 220EVP have backlit CGA LCD screens, the rest of the range uses a backlit EGA LCD. Mitsubishi's design does not allow the user to pry open the case; instead, the company includes a tool for installing the optional proprietary memory and video boards.

Standard equipment for the 240EVP includes 640K RAM on the motherboard, expandable to 2MB, switchable 12- or 8-MHz speeds (with one or zero wait states), Phoenix BIOS, a NEC 40MB hard disk, an external port for a CGA or EGA monitor, *Microsoft Windows*, *Super PC-Kwik*, DOS 3.3, GW-BASIC, Mitsubishi's own expanded memory manager, a math co-processor, and a one-year warranty.

While the screen itself is eminently readable, it is difficult to adjust. Brightness and contrast are set by two flat thumb-screws that can't be set once and ignored because the screen changes with every application. Too bad; while text characters, slightly rounder and larger than the norm, are very legible, graphics can be wrecked by blooming and streaking.

The MP 286L's 84-key keyboard is a fair example of the breed: the complete set of function and cursor keys are arranged along the top in two rows of half-sized keys that are fiddly to use and not wholly logical in execution. Interestingly, there is an unlabeled key at the bottom of the keyboard between the Alt and Ctrl keys that will perform the backslash function. It's convenient but odd, particularly since the manual doesn't mention it.

At almost 16 pounds, users could be



Mitsubishi MP 286L/240EVP

Mitsubishi Electronics America Inc., 991 Knox St., Torrance, CA 90502; (213) 515-3993.

List Price: With 640K RAM, 40MB hard disk, 1.44MB 3.5-inch floppy disk drive, EGA liquid crystal display, 2,400-bps modem, one parallel and two serial ports, DOS 3.3, GW-BASIC, *Microsoft Works*, *Super PC-Kwik*, *Mitsubishi External Memory Manager*, carrying case, \$4,795; with 2.6 MB RAM, \$5,994.

In Short: While the 12-MHz MP 286L/240EVP is weighty and lacks a battery, such redeeming features as a raft of software, solid performance, and rugged construction make it a machine worth considering.

CIRCLE 606 ON READER SERVICE CARD

forgiven for thinking that the Mitsubishi is packing a sizable battery to back up its AC capability. When Mitsubishi designed the MP 286L two years ago, the company looked at a number of third-party battery sources but opted out. Mitsubishi currently does not plan to offer an MP 286L model with a battery.

The Mitsubishi MP 286L/240EVP turned in respectable results during testing, but it shouldn't be judged on that alone. It is very rugged; a lifetime of hard use won't faze it. The lack of battery power will affect only those who absolutely cannot live without it.

NEC TECHNOLOGIES INC.

NEC PowerMate Portable Plus

by M. David Stone

The \$4,999 NEC PowerMate Portable Plus is a kind of poor country-cousin to NEC's PowerMate Portable SX (reviewed in the 386 section). Priced \$1,000 less than the SX, this 12-MHz 80286-based machine shares the same high-quality construction, one-year warranty, and FCC Class B rating. It also uses the same 11.25- by 16- by 8-inch (HWD) lunchbox chassis and sports an identical keyboard. Beyond

the clear family resemblance, however, the two systems have little in common.

Our tested configuration, which weighed in at over 20 pounds, includes 1MB RAM, a 42MB hard disk drive, a 1.44MB 3.5-inch floppy disk drive, a VGA LCD display, DOS 3.3, and GW-BASIC. Get the 23-millisecond 118MB hard disk drive, and the price jumps to \$5,999.

NEC's version of the lunchbox design opens from the top. Look down into the system, and you'll see the three easily accessible, full-length 16-bit slots on a board mounted perpendicular to the motherboard. None of the slots were filled in the review unit, leaving plenty of room for expansion. And although the 80-watt power supply seems small, NEC claims that the combination of low-power drives, LCD screen, and efficient NEC chips leaves plenty of power available for expansion.

The NEC motherboard is mounted on the back of the system. It includes a Phoenix BIOS, Paradise PVGA1A chip set, one parallel and one serial connector, a NEC chip set, the 12-MHz 80286, and a socket for a 10-MHz 80287 math coprocessor. The disk controller is a daughterboard made by National Computer Ltd. The 1MB of 80-nanosecond RAM on the review system is the maximum that will fit on the motherboard itself. However, an optional daughterboard will take up to 3MB more.

The memory option—which was not

included with the review system—comes with 1MB of 80-ns. RAM and has room for two additional 1-megabit SIP modules. If you need more than 4MB in the system, you can increase it to 16MB total with standard 16-bit memory cards. Pricing for the high-speed memory had not been determined at this writing, but NEC expects the daughterboard to sell for \$695 with 1MB, and the 1MB modules, \$575 each.

The greatest disappointment in this system is the backlit LCD VGA display. As shipped, the display shows black letters on a white background, though it can easily be changed to white letters on black background. Alas, either way, persistent ghost images interfere with scrolling and reading the text.

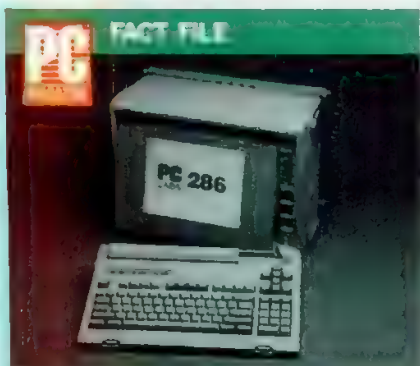
Also, there is no way to change the mapping for the eight shades of gray. The mapping is defined to maximize text readability with programs designed for color. However, if text and background happen to be mapped to the same shade of gray, you have no way to change them. And on the gray-scale test picture of a human face, this particular mapping turns the image into a horror mask on the LCD screen. With color pictures, the mapping yields reasonable images.

The PowerMate Portable Plus is a solid implementation of a somewhat flawed design. The LCD screen constitutes its worst limitation. And at \$4,999 for a 12-MHz 80286-based portable, you should expect a more readable screen, even as an option. But if the basic design interests you, consider the PowerMate Portable SX as well.

DOS, communications, and utility software. The system includes one parallel and one serial port, external VGA monitor jack, and an AT-style keyboard. Also available are a 40MB hard disk drive for a system price of \$5,599, or a 100MB hard disk drive for \$6,999. All prices include a one-year warranty. Our \$5,897 review unit included a 20MB drive, an optional battery pack, and an internal 2,400-bit-per-second modem.

Inside the box is a NEC motherboard with a Harris 80C286 processor, a Chips and Technologies chip set, Phoenix BIOS, a Chips and Technologies VGA chip set, and a socket for an 80C287 math coprocessor. Three easily accessible compartments have proprietary slots for adding memory or various connectivity options. One compartment has a dedicated slot for either a \$799 1MB RAM card or a \$2,499 4MB RAM card. A second slot is meant for the optional modem. NEC also expects to offer two fax cards: one of these will be able to send only faxes; the other will be able to send and receive faxes and will have an MNP Level 5 error-correcting modem on-board.

The NEC LTX slot can take a variety of cards, including an Ethernet or StarLAN card, an SCSI adapter, a Remote 3270 card, the optional expansion chassis con-



NEC PowerMate Portable Plus

NEC Technologies Inc., 1414 Massachusetts Ave., Foxborough, MA 01719; (800) NEC-INFO, (508) 264-8000.

List Price: With 1MB RAM, 42MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA liquid crystal display, one parallel, one serial port, utilities, DOS 3.3, GW-BASIC, \$4,999.

In Short: The 12-MHz NEC PowerMate Portable Plus offers high-quality construction, a good keyboard, VGA graphics, and a choice of 42MB or 100MB hard disk drives, limited by a poor LCD display.

CIRCLE 609 ON READER SERVICE CARD

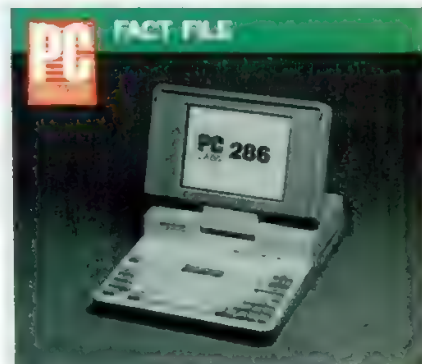
NEC TECHNOLOGIES INC.

NEC ProSpeed 286

by M. David Stone

According to NEC, the ProSpeed 286 is a laptop computer, but given its 16 pounds and 3.5- by 12.9- by 14.75-inch (HWD) dimensions, you may disagree. This 80286-based 16-MHz system is better thought of as a medium-weight portable in a clamshell design. If you want to appreciate its portability, the appropriate comparison is to 20-pound lunchboxes, not lightweight laptops.

The \$5,099 base price includes 1MB RAM, a 27-millisecond 20MB hard disk drive, a 1.44MB 3.5-inch floppy disk drive, a VGA-compatible LCD display,



NEC ProSpeed 286

NEC Technologies Inc., 1255 Michael Dr., Wood Dale, IL 60191; (800) FONE NEC, (708) 860-9500.

List Price: With 1MB RAM, 20MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA liquid crystal display, one parallel, one serial port, utilities, DOS 3.3, \$5,099; with battery pack, 2,400-bps internal modem, \$5,897. Optional carrying case, \$129; expansion station, \$899.

In Short: The 16-MHz NEC ProSpeed 286 offers a modified enhanced keyboard layout, a highly readable backlit LCD VGA screen, a choice of 20-, 40-, or 100MB hard disks, and a great deal of expandability for a clamshell design. However, at this price, you can easily find better performance on the one hand or smaller size and weight on the other.

CIRCLE 610 ON READER SERVICE CARD

PORTABLES 286-BASED

nector, a \$1,099 memory card, or various third-party cards. The alternate memory card comes with 2MB RAM and can be expanded to 4MB, allowing a 9MB system total.

A removable AC power module doubles as a battery charger. Simply slide out the AC module and slide in the \$199 battery pack. NEC claims 1.5 to 3 hours of battery life. Alternatively, you can get the \$399 battery "slice" option, with its claimed 3- to 5-hour life. NEC also sells a car battery adapter for \$20.

For expandability at home base, NEC offers an \$899 expansion chassis with one 8-bit slot and three 16-bit slots. The chassis plugs into a connector, which installs in the ProSpeed's NEC LTX slot with one screw.

The backlit LCD screen offers VGA-compatibility and 16 shades of gray. As shipped, it offers a reverse white background, with good readability for text. With the default mapping, the 16-shades-of-gray test image of a human face looked like the negative of a black-and-white photo. However, remapping the image is straightforward and produces an acceptable picture.

As for competition with other portables, the ProSpeed 286 has two strikes against it: it's expensive for what it does, and the Compaq LTE/286 has just redefined the market. For the \$5,099 base price of the ProSpeed 286, you can get the notebook sized LTE/286 with twice the disk capacity and less than half the weight—and still have money left over for plane fare. The NEC ProSpeed 286 is strong on expandability if you need it, but at these prices, you might want to take a look at a 386 or 386SX systems (reviewed in the 386 section) instead.

PACKARD BELL **Packard Bell PB286LP** by Bruce Brown

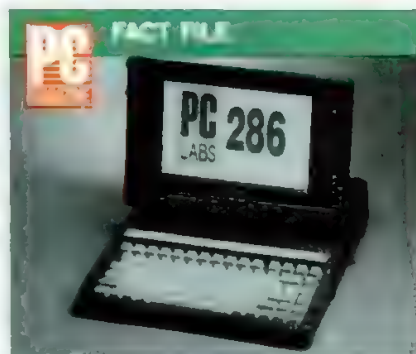
Packard Bell's laptop weighs in at a hefty 16-plus pounds, including its 3.5-pound removable, rechargeable nickel cadmium battery—on the high side for clamshell 80286-based portables. But that battery may make the sore shoulder worth the schlep: it lasted almost 3 hours in our grueling battery rundown test. The PB286LP's \$3,995 list price includes

1MB RAM, a 20MB hard disk drive, 1.44MB 3.5-inch floppy disk drive, CGA-mode LCD, one serial and one parallel port, and DOS 3.3. Our test version with a 40MB hard disk lists for \$4,495.

The Packard Bell uses an Intel chip set and Award's ROM BIOS. Setup, diagnostics, and a convenient password system are all stored in ROM. Somewhat unusual in a 286, the Packard Bell has switchable system ROM shadowing, letting you use the upper 384K either to shadow the system ROM or to configure it as expanded or extended memory.

The standard 1MB of zero-wait-state, 80-nanosecond RAM can be increased to 5MB maximum using 1-megabit SIMM modules. Packard Bell leaves the sale of memory modules to the dealers who sell the machines. The company doesn't sell math coprocessors either, but the PB286LP does have a slot for an 8-MHz 80287 coprocessor. The major option offered by Packard Bell is an internal 2,400-bit-per-second Hayes-compatible modem, priced at \$269.

The PB286LP features an exceptionally clear, black-on-white, 640- by 400-pixel double-scan CGA- and MDA-compatible display. This screen is terrific for text, though there was a bit of irritating flicker in full graphics modes. The 1.62 aspect ratio flattens graphics images just a bit, not enough to be a bother. Depending on the mode, the screen can display up to 16 shades of gray.



Packard Bell PB286LP

Packard Bell, 9425 Canoga Ave., Chatsworth, CA 91311; (818) 773-4400.

List Price: With 1MB RAM, 20MB hard disk, 1.44MB 3.5-inch floppy disk drive, backlit LCD CGA display, one serial, one parallel port, DOS 3.3, \$3,995; with 40MB hard disk, \$4,495.

In Short: The Packard Bell PB286LP has a clear screen and close to a 3-hour tested battery life. A fine, if slightly heavy, road machine.

CIRCLE #11 ON READER SERVICE CARD

The 82-key keyboard has ten function keys across the top of the keyboard, an embedded numeric keypad, and a separate cursor keypad. Everything is great about this keyboard except that there's no unshifted asterisk key—a minor aggravation, perhaps, but one of which heavy file manipulators should be aware.

When not running on battery power, the PB286LP runs on a 2.25- by 3- by 6.5-inch (HWD) AC adapter. This unit recharges a spent battery in 3 to 6 hours, depending on whether the computer is used during the recharging time.

All told, the Packard Bell PB286LP is a strong laptop contender. At \$3,995 for the 20MB version, it's priced a bit high, but then, as usual for computers sold only through dealers, you can probably get a discount. If you need a 80286-based portable with 3-hour battery life and a good screen that doesn't have to be EGA or VGA, the Packard Bell is a good bet.

PC BRAND INC.

PC Brand Portable PC III 286/12

PC Brand Portable PC III 286/20

by Robin Raskin

PC Brand's \$4,658 286/20 and \$4,535 286/12 Portable PC IIIs are lunchbox machines reminiscent of the way my mother used to pack a lunchbox: full of goodies, but without much regard for weight. PC Brand gives you full-sized 80286-based AT components squished into two luggage lunchboxes; but at just under 25 pounds each, these FCC Class A-rated machines are among the heaviest in the portable category.

The PC Brand case is rugged, with a carrying handle meant to last. The built-in VGA gas plasma monitor rises up and then tilts forward for use but lacks the full range of tilt found in other portables. The 86-key Alps keyboard houses a short 18-inch keyboard cable that is scrunched into a casing beneath the keyboard. The cable connects to the back of the PC Brand machine, snaking its path from beneath the keyboard to the rear. Because of this, you must use the feet on the keyboard at all times. The front panel has a reset button, power-on LED indicator, and LED disk access light, but no dedicated turbo indicator.

Peter Norton on Paul Mace:

New
1990 Version

"The *Mace Utilities* include a recovery program that attempts to recover as much data as possible from a hard disk that has been reformatted, and that hasn't been protected by a 'snapshot' utility. This is the *ultimate* recovery utility..."

—Peter Norton
The Hard Disk Companion, p. 338

"Thank you, Peter."

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CIRCLE 236 ON READER SERVICE CARD



FIFTH GENERATION SYSTEMS The Creators of FastBack

10049 N. Reiger Road Baton Rouge, LA 70809 (504) 291-7221

PORTABLES 286-BASED

These portables both use the same size of boards and disks that you'd find in a regular desktop AT. Virtually the only difference between the two machines is their clock speed, and our benchmark tests reflect these differences predictably.

The 286/12 uses a PC Brand motherboard, with setup and diagnostics built into the AMI BIOS and extended setup on diskette. The 286/20 uses an Addonics motherboard, has both setup and extended setup in ROM, but does not include diagnostics. The 286/20 uses SIP- and/or DIP-mounted chips. The 286/12 uses only SIP. This makes the 20-MHz machine a safer choice for those who hedge their bets against future RAM crises. The machines come with 512K RAM and can accommodate up to 8MB of memory on their motherboards. You can choose to shadow video BIOS, ROM BIOS, or both through an easy-to-use ROM setup.

As with other lunchbox portables, the

power supply blocks access to all but the one 8-bit and two 16-bit slots. Our test machines, which included Adaptec disk controllers, serial/parallel I/O boards, and VGA video cards, left only two 16-bit slots free.

Both machines came configured with a standard half-height 85MB MiniScribe hard disk, a Mitsumi 5.25-inch hard disk drive, and a TEAC 3.5-inch floppy disk drive. You can have as many as three externally accessible drives—a bonus if you're thinking about a combination CD ROM/floppy/hard disk drive. PC Brand claims it wants to keep components standard and therefore relies on the traditional half-height hard disk drive form factor. However, small-footprint hard drives have become an increasingly popular standard and would certainly knock a few pounds off of these chubby fellows.

Our 286/20 was tested with the speedy Prism VGA board, while the 286/12 comes with a slower PC Brand board that's a clone of the Paradise VGA board. Spokespeople at PC Brand claim that the Prism is touchier with respect to timing and doesn't work well in the 12-MHz machine. In light of VGA improvements, the company expects to use Prisms in both machines in the near future.

Our systems had built-in, 16-shade gray-scale VGA gas plasma monitors. The VGA boards also had ports for an external VGA monitor. A daughterboard reads the signal off the VGA board and sends it to the built-in monitor. Oddly, the signal sent to the built-in monitor is digital, and the signal sent to the external monitor is analog. Because the internal monitor in the PC Brand Portables is not 100 percent VGA compatible, we found minor incompatibilities in almost every VGA test image. Despite the fact that the built-in display screen is quick, responsive, and highly readable, this might not be the machine of choice for graphics-intensive applications.

PC Brand supplies a broad selection of options: midrange hard disk drives, PC Brand mouse, 1,200- or 2,400-bit-per-second modems, DOS 4.1 (\$70), a number of built-in monitors, even a Colorado Memory Systems tape backup unit. Also available are 150MB SCSI hard disk drives. All machines come with a nylon carrying case.

PC Brand service was friendly, competent, and knowledgeable. In addition to highly visible invitations throughout the

documentation to use toll-free telephone support, the company even has a toll-free fax number. The manuals we looked at were in final draft versions, but they appeared to be first rate. If you don't mind a sore shoulder from lugging one of these puppies around, PC Brand will help you configure your dream machine in any way you choose.

SHARP ELECTRONICS CORP.

Sharp PC-5541

by Bruce Brown

The \$5,595 Sharp PC-5541 is an attractive, battery- or AC-powered 12-MHz 80286-based computer with an LCD VGA display in a clamshell case. Despite its high price and near-14-pound weight, you might put this Sharp computer on your winners' list.

There aren't many options for the PC-5541: the base configuration includes 640K RAM, 40MB hard disk drive, 1.44MB floppy disk drive, backlit double-supertwist LCD VGA display, one serial and one parallel port, and DOS 3.3. A 1MB RAM upgrade costs \$845, 2MB extra costs \$1,495—though these prices seem unrealistic given today's memory costs. There are also a pair of carrying cases: nylon for \$99 and leather for \$199. A 1,200-bit-per-second modem with second serial port lists for \$399; a 2,400-bps variety is \$449.

The PC-5541 uses an internal 2,200



PC Brand Inc., 954 W. Washington St., Chicago, IL 60607; (800) PC BRAND, (312) 226-3500.

PC Brand Portable PC III 286/12

List Price: 512K RAM, 40MB hard drive, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, VGA gas plasma display, one parallel, one serial port, utilities, carrying case, \$2,995; with 1MB RAM, DOS 4.01, \$3,145; with 4MB RAM, 71MB hard disk, \$4,106; with 8MB RAM, one 1.44MB 3.5-inch and one 1.2MB 5.25-inch floppy disk drive, DOS 4.01, \$4,535.

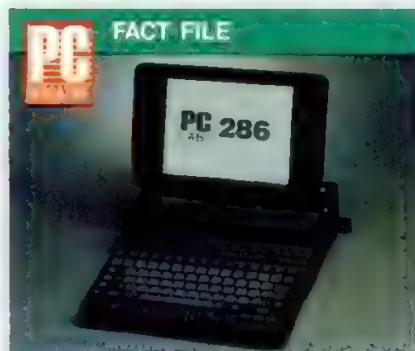
CIRCLE 612 ON READER SERVICE CARD

PC Brand Portable PC III 286/20

List Price: 512K RAM, 40MB hard drive, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, VGA gas plasma display, one parallel, one serial port, utilities, carrying case, \$3,195; with 1MB RAM, DOS 4.01, \$3,337; with 8MB RAM, 85MB (71MB formatted) hard disk, one 1.44MB 3.5-inch and one 1.2MB 5.25-inch floppy disk drive, DOS 4.01, \$4,658.

In Short: Packed to the gills, these 286-based machines offer desktop-in-a-lunchbox performance—with the added drive configurations to prove it—but you'll work up an appetite as you carry these hefty machines around.

CIRCLE 613 ON READER SERVICE CARD



Sharp PC-5541

Sharp Electronics Corp., Sharp Plaza, Mahwah, NJ 07430; (800) BE SHARP, (201) 529-9500.

List Price: With 640KB RAM, 40MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA liquid crystal display, one parallel and one serial port, DOS 3.3, \$5,595; with 1.6MB RAM, \$6,440.

In Short: The Sharp PC-5541 is an attractive, moderately powerful laptop with a good screen and a higher-than-expected price. Good stuff, but it costs too much.

CIRCLE 614 ON READER SERVICE CARD

You are surrounded by a bunch of losers.



"Uh, my system crashed and my file disappeared."



"Have you ever had one of those days?"



"My dog ate my data."



"I can't believe that it's my fault, it's your system."



"Nobody told me that I was supposed to back up."



"I think I'm in trouble here."

If you manage PCs, you've heard every conceivable excuse from your users.

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Irwin Tape Backup Systems are fast, easy-to-use, and best of all: they operate unattended.

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XTree-like features.
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FIND FILES	✓	✓	✓	✓
COPY / MOVE FILE CONTENTS	✓	✓	✓	✓
VIEW FILES	✓	✓	✓	✓
OPEN / ASSOCIATE APPLICATION	✓	✓	✓	✓
SPLIT WINDOWS	✓	✓	✓	✓
PRUNE / GRAFT	✓	✓	✓	✓
GLOBAL FILE VIEWS	✓	✓	✓	✓
COLLAPSE DIRECTORIES	✓	✓	✓	✓
HIDE / UNHIDE DIRECTORIES	✓	✓	✓	✓
FORMAT DISKS	✓	✓	✓	✓
TOGGLE / MERGE TAGGED FILES	✓	✓	✓	✓
REVERSE FILE SPECS	✓	✓	✓	✓
COPY ORIGINAL DIRECTORY STRUCTURE	✓	✓	✓	✓
DATE / TIME STAMP FILES	✓	✓	✓	✓
PRINT DIRECTORY TREE	✓	✓	✓	✓
CHANGE FILE ATTRIBUTES	✓	✓	✓	✓
RENAME A VOLUME	✓	✓	✓	✓
ARCHIVE MANAGER	✓	✓	✓	✓
EGA / VGA SUPPORT	✓	✓	✓	✓
MOUSE SUPPORT	✓	✓	✓	✓

mA/hour nickel cadmium battery, which Sharp rates at a 2-hour life and a 4-hour recharge time. Our battery rundown benchmark test lasted just 1 hour and 23 minutes with 640K installed. Sharp has an additional battery option, a 4,000 mA/hour add-on battery pack that attaches to the rear of the unit. We didn't test it, but a conservative estimate is that this \$399 option would add 2.5 hours or more of operating time. The standard AC adaptor weighs 1.6 pounds and is quite bulky at 3.4 by 6.9 by 2.25 (HWD) inches.

The 640- by 480-pixel screen provides good contrast, and supports MDA, CGA, EGA, and VGA modes internally, with 16 shades of gray. A minor criticism: you can see the backlight tubes behind the LCD screen. There are both 9-pin and 15-pin ports for an external monitor, which support the same modes as the internal display and also Hercules Graphics mode. In addition to brightness and contrast controls, there's a switch that changes the video display to light on dark from the default dark on light.

The Sharp uses its own 80286 chip set and Phoenix Technologies' ROM BIOS. The motherboard can hold just the standard 640K RAM, but the 1MB or 2MB add-on modules install easily into a compartment on the bottom of the case. There are no internal expansion slots. An external expansion chassis is planned, but no details were available when we reviewed the machine.

The 79-key keyboard has 12 function keys across the top, an embedded numeric keypad, and a separate cursor control set. Because the Sharp case is fairly deep, there's a bit of room left in front for a wrist rest. There's also an external PS/2-compatible keyboard port.

There's a lot to like about the PC-5541, but the pricing is enough to make this reviewer hesitate. Since Sharp computers are sold only through dealers, you might snag a good discount. This solid performer might be a star for \$1,000 less.

TANDON CORP.

Tandon LT/286

by Bruce Brown

Looks may not be everything in laptops, but looking at your laptop may be—as demonstrated by Tandon's \$3,874 12-MHz battery-powered LT/286. By using dual-panel LCD technology with a fast re-

fresh rate, the LT/286's PC Labs EGA video benchmark times are among the fastest in its class.

The blue-and-gray LCD screen is very bright and is capable of displaying up to 16 shades of gray in EGA mode. There are both brightness and contrast controls, as well as a keyboard sequence to switch between light-on-dark and dark-on-light display modes. An external 9-pin video port lets you plug in an external EGA monitor.

The case measures 3.4 by 12.4 by 13.25 inches (HWD). With the internal removable battery installed, the total weight is over 13 pounds. The list price includes 1MB RAM, a 24-millisecond 21MB Conner hard disk drive, 1.44MB floppy disk drive, the EGA LCD screen, one serial and one parallel port. DOS 3.3 is a \$42 option.

The LT/286 has a dual-speed 6- or 12-MHz processor on a Tandon motherboard with Chips and Technologies 286 chip set and Tandon ROM BIOS. The ROM BIOS includes both system setup and diagnostics and a three-level password protection system. The LT/286's standard one-wait-state 1MB RAM can be expanded to a maximum of 5MB using 100-nanosecond page-mode 2MB SIMM modules, the price for which was not set at press time.

The Conner drive has a built-in drive controller, leaving the Matsushita floppy disk drive to be managed by a NEC 765 chip on the motherboard. Tandon doesn't sell optional larger hard disk drives for this

particular model.

There's one expansion slot in the LT/286 reserved for an internal 2,400-bit-per-second modem option, the price of which is yet to be set. An external expansion chassis with three 8-MHz 16-bit slots is planned but also not yet available.

The 82-key keyboard's half-sized ScrollLock, Fn, and Pause keys may be awkward for keystroke combo-intensive applications such as *WordPerfect*. Luckily, there are ports for both an external keypad and an external keyboard.

The LT/286 lasted just over 2 hours on our demanding battery rundown test. There are screen and hard drive power conservation utilities to power-off those components. Recharging the battery can take up to 14 hours; extra 1.75-pound battery packs will be priced at approximately \$75. The 1.5-pound AC adapter/power transformer is a bit bulky at 2.1 by 3.1 by 6.5 (HWD) inches.

All Tandon machines are sold with a 12-month parts-and-labor warranty and are serviced through dealers.

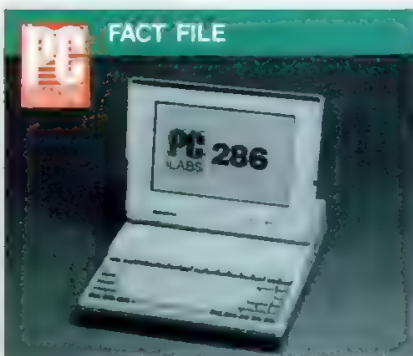
The Tandon's screen is so good that I could overlook the half-sized function keys, slow battery recharge time ratio, and lack of hard disk drive expansion. If I felt I needed an 80286-based machine for the road, I'd certainly consider the LT/286.

TEXAS INSTRUMENTS INC.

TravelMate LT286

Model 12

by Mitt Jones



Tandon LT/286

Tandon Corp., 609 Science Dr., Moorpark, CA 93021; (805) 523-0340.

List Price: With 1MB RAM, 20MB hard disk, 1.44MB 3.5-inch floppy disk drive, EGA backlit LCD screen, one serial and one parallel port, \$3,832; with DOS 3.3, \$3,874.

In Short: The Tandon LT/286's attractive screen is the best feature of this otherwise standard machine. A better-than-2-hour battery life and a sub-15-pound curb weight make this machine worth a gander.

CIRCLE #18 ON READER SERVICE CARD

While the Compaq LTE/286 wins top honors when it comes to squeezing the most machine into the smallest case, Texas Instruments' TravelMate LT286 Model 12 ranks a strong—and surprisingly affordable—second, at least where 286 machines are concerned.

Weighing in at 6.7 pounds, the star of TI's new 12-MHz laptop lineup comes base configured with 1MB RAM, a 20MB hard disk, backlit CGA display, and a removable nickel cadmium battery pack, all for a list price of \$4,199. That price also includes DOS 3.3, *LapLink*, and other software tucked away in ROM.

Unfortunately, the basic configuration includes no floppy disk drive, and therein lies the biggest failing of the LT286 Model 12. If you demand a floppy disk drive, as most of us do, you'll have to deal with the

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***Suggested U.S. list prices:
LaserJet IIP \$1495;
LaserJet Series II \$2695.
Dealer prices vary.**

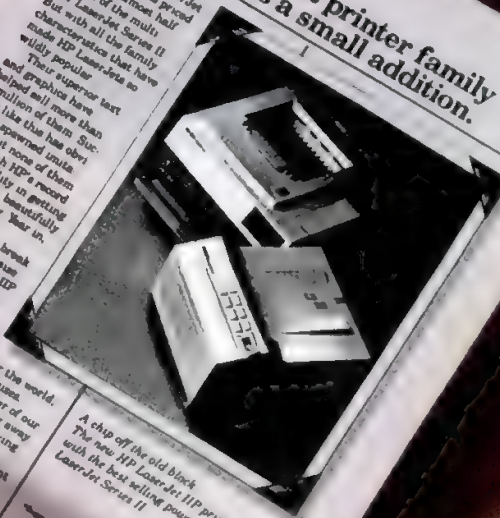
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A chip off the old block. The new HP LaserJet IIP printer (front) with the best-selling powerhouse LaserJet Series II.

*Suggested U.S. list price.

The new HP LaserJet IIP printer.

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CIRCLE 305 ON READER SERVICE CARD



BENCHMARK TESTS: 286-BASED PORTABLES

The 16-MHz Dynabook 286 best combines fast processing, good disk performance, and exceptional VGA video in a battery-powered machine. PC Brand's AC-only 20-MHz Portable

PC III 286/20 emerges as the fastest portable 286, but the Micro Express Regal 286 isn't far behind, especially with its fast and powerful 177MB ESDI hard disk.

PROCESSOR AND MEMORY BENCHMARK TESTS

80286 Instruction Mix

The **80286 Instruction Mix** benchmark test times a series of tasks specific to the 80286 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.



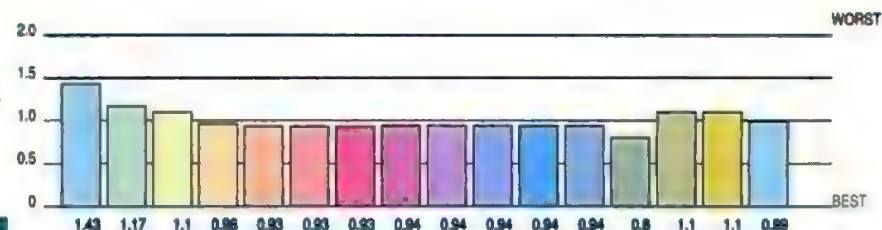
Floating-Point Calculation Without Coprocessor

The **Floating-Point Calculation Without Coprocessor** benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.



Conventional Memory

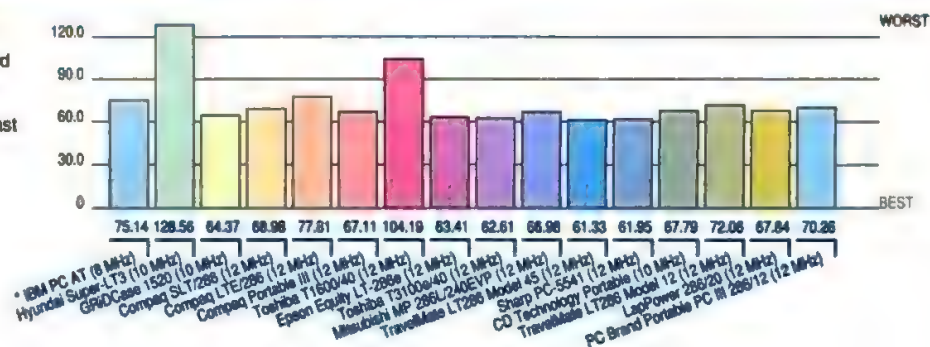
The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.



DISK BENCHMARK TESTS

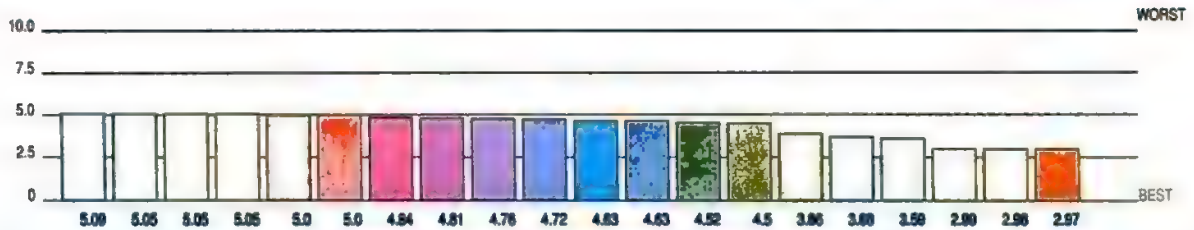
DOS File Access (Small Records)

The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.

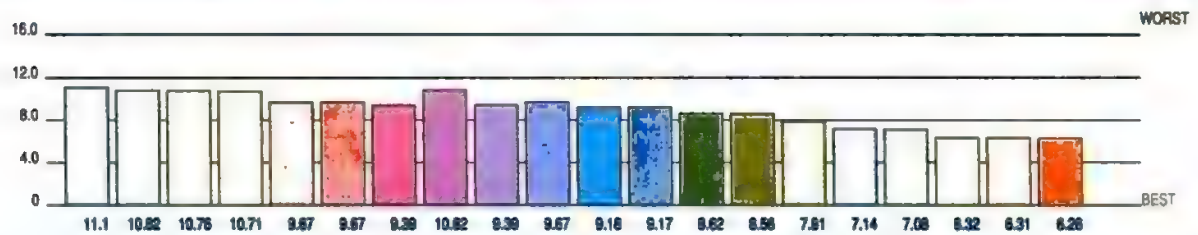


* Reported for comparison.

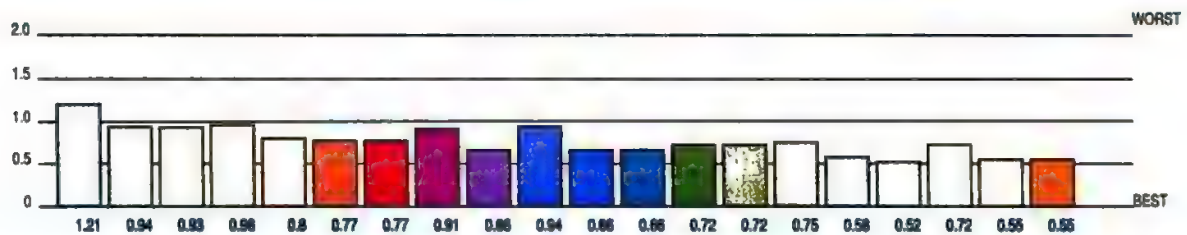
Elapsed Time (seconds)



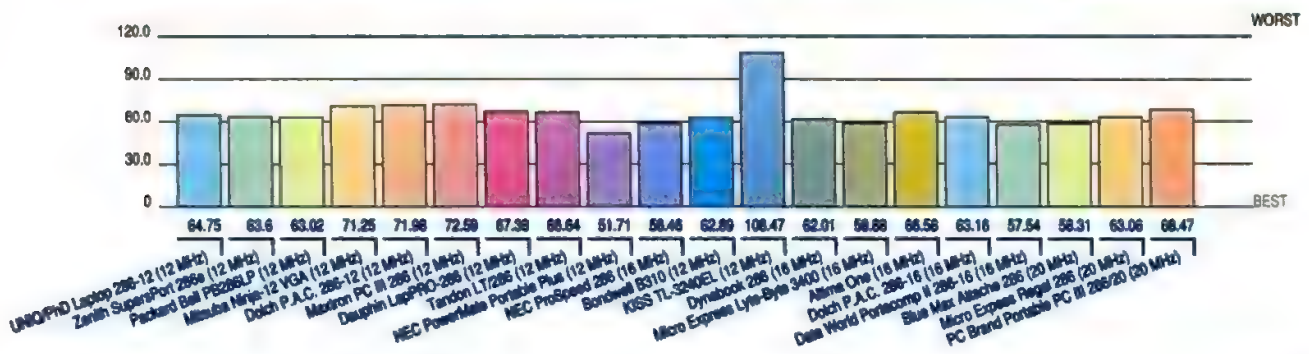
Elapsed Time (seconds)



Elapsed Time (seconds)



Elapsed Time (seconds)



CONTINUES



TravelMate LT286 Model 12

Texas Instruments Inc., P.O. Box 202230, Austin, TX 78720-2230; (800) 527-3500.

List Price: With 1MB RAM, 20MB hard disk, CGA liquid crystal display, DOS 3.3, GW-BASIC 3.2, utilities, \$4,199; with 3.5-inch 1.44MB snap-on floppy disk drive, \$4,498; with 2,400-bps internal modem, \$4,947.

In Short: The LT286 Model 12 packs a 2.5-inch, 20MB hard disk, battery pack, and backlit screen into a reasonably priced 3.2- by 11.4- by 8.2-inch (HWD) laptop. Floppy disk drive available as external option only.

CIRCLE 619 ON READER SERVICE CARD

external 3.5-inch 1.44MB model, a \$299 option that fits directly onto the "modular expansion port" on the right side of the machine.

The Model 12 also depends on the modular expansion connector to furnish its parallel port. When connected, the external floppy disk drive supplies the port via its back panel. Otherwise, you'll need the parallel port adapter, which measures 5.2 by 2.2 by .9 inches and comes standard with the machine.

Measuring 11.4 inches wide by 8.2 inches deep, the Model 12 occupies a footprint roughly the size of a standard sheet of paper. With a thickness of 3.2 inches, however, the machine seems a bit too thick to qualify as a true "notebook" portable. It's easy enough to carry in its own bag—and far easier to carry than most 286 portables—but you may have a hard time squeezing it into your briefcase, especially if you carry other things in it.

The 20MB hard disk, rated at 23 milliseconds, comes courtesy of Conner Peripherals. While Compaq makes use of Conner's low-profile 3.5-inch hard drive in its LTE and LTE/286, Texas Instruments opted for the new 2.5-inch model. This disk is so small and quiet that it's impossible to figure out where it sits in the Model 12 without dismantling the machine.

The Model 12's backlit supertwist LCD display also ranks among the machine's

PORTABLES 286-BASED

strong points, though its CGA graphics may be insufficient for some users. Measuring a generous 7.8 inches wide by 5.9 inches high, the display produces 640 by 200 pixels and four gray scales. Text is crisp and easy to read, and a single sliding adjustment along the top of the machine provides ample flexibility.

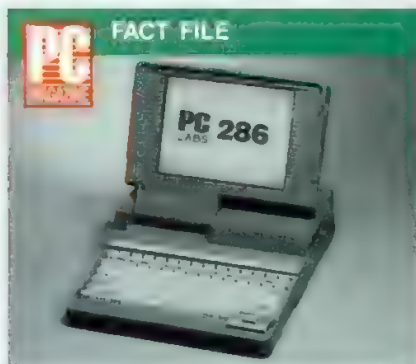
The 84-key keyboard gets mixed reviews. Unlike the keyboards of many of the down-sized laptops, the keys themselves are full sized—not only spaced at standard intervals but of standard height and with standard key travel. The key action can't compare to that of a good ol' IBM keyboard, but it's as good as you'll find with many clone keyboards. On the downside, the layout of the keyboard will pose a few challenges. The cursor keys, for instance, rest in a cluster at the upper right of the keyboard, with the Insert, Delete, End, and Home keys a bit to the left.

TI rates the Model 12's nickel cadmium battery pack at 3 hours of use, but that figure assumes you'll be using the machine's power conservation measures, which shut down the screen and hard disk after periods of inactivity and cycle the processor down

to 6 MHz. The machine lasted only 1 hour and 40 minutes on the PC Labs battery run-down test. If battery longevity ranks high on your list of priorities, you may want to opt for an additional battery pack, which TI sells for \$129.

TI has made changing the battery a bit inconvenient: though accessible via a slide-out panel, the battery must be disconnected from the machine by removing the power leads from a small connector. Still, a removable battery pack that's not terribly convenient rates far preferable to a battery pack that can't be removed at all.

The Model 12's 1MB of motherboard RAM can be upgraded to 3MB as a factory option. A socket along the front edge of the machine accepts an additional 1MB RAM or ROM card. If you want the smallest, most complete 286 laptop at any price, the Compaq LTE/286 is your machine. But if you'll put up with a larger, less convenient machine in return for a lower price, the TravelMate LT286 Model 12 stands as an attractive alternative.



TravelMate LT286 Model 25

Texas Instruments Inc., P.O. Box 202230, Austin, TX 78720-2230; (800) 527-3500.

List Price: With 1MB RAM, 20MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA liquid crystal display, one parallel, one serial port, utilities, DOS 3.3, GW-BASIC 3.2, \$4,999; with internal 2400-bps modem, \$5,598.

CIRCLE 620 ON READER SERVICE CARD

TravelMate LT286 Model 45

List Price: With 1MB RAM, 40MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA liquid crystal display (CCFT), one parallel, one serial port, utilities, DOS 3.3, GW-BASIC 3.2, \$5,599; with internal 2,400-bps modem, \$6,198.

In Short: Although solidly built and offering a few nice touches, the LT286 Models 25 and 45 fail to stand out from the crowd.

CIRCLE 621 ON READER SERVICE CARD

TEXAS INSTRUMENTS INC.

TravelMate LT286 Model 25 TravelMate LT286 Model 45

by Mitt Jones

Don't be surprised if you feel a wave of déjà vu coming over you as look at TI's TravelMate duo. Aside from their slightly different keyboard and case colorings, Texas Instruments' 12-MHz TravelMate LT286 Models 25 and 45 and the Sharp PC-5541 are identical machines. According to a TI representative, Sharp designed the machines with some input from TI. The representative added that TI does some custom manufacturing for Sharp and also handles the manufacture of its version of the machine.

The separate TravelMate model numbers indicate only a difference in hard disk drive size: 20MB for the \$4,999 Model 25 and 40MB for the \$5,599 Model 45. Both machines weigh 14 pounds in their standard configuration and come with 640K RAM, one 3.5-inch 1.44MB floppy disk drive, a backlit LCD VGA-compatible display, a rechargeable nickel cadmium battery pack, and a few other notable features. Our evaluation unit was the Model

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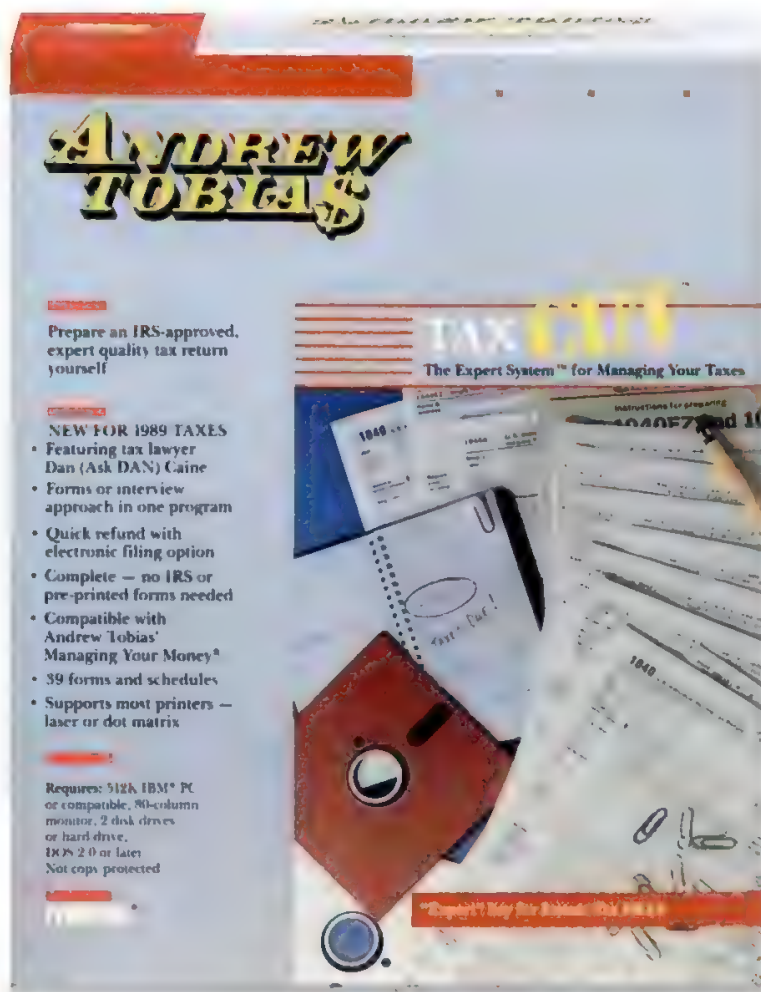
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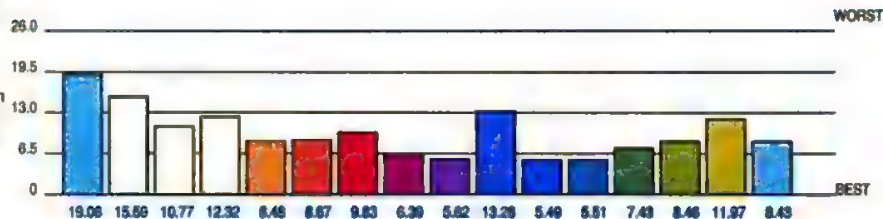


BENCHMARK TESTS: 286-BASED PORTABLES

DISK BENCHMARK TESTS

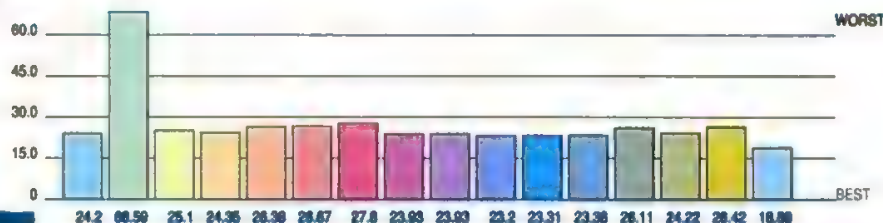
DOS File Access (Large Records)

The **DOS File Access (Large Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.



BIOS Disk Seek

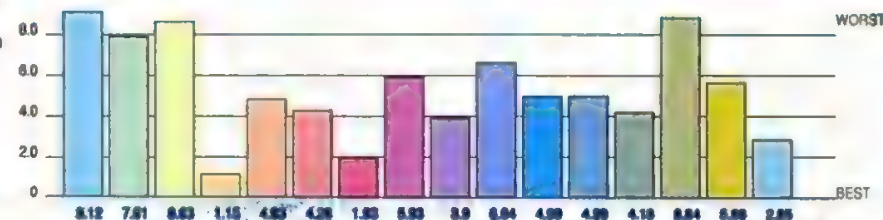
The **BIOS Disk Seek** benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.



VIDEO BENCHMARK TESTS

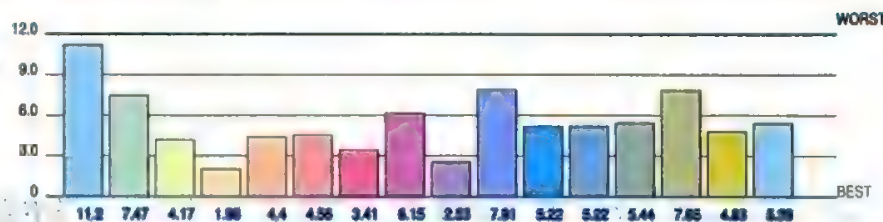
Direct to Screen

The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.



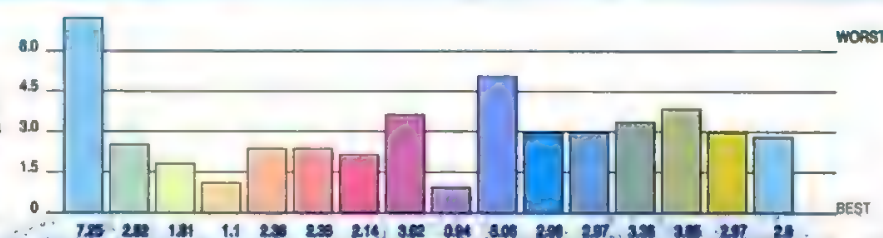
Video BIOS Routine with Scrolling

The **Video BIOS Routine with Scrolling** benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.



Video BIOS Routine Without Scrolling

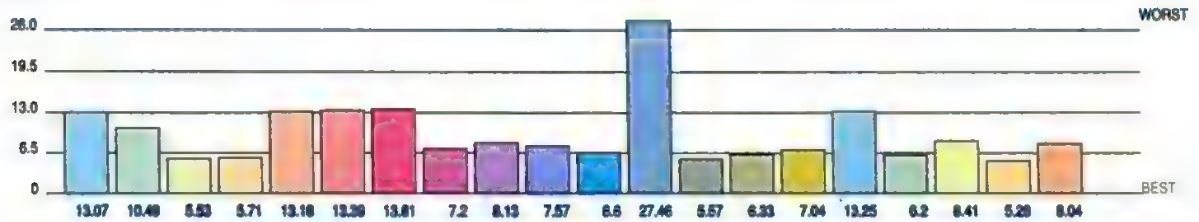
The **Video BIOS Routine Without Scrolling** benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.



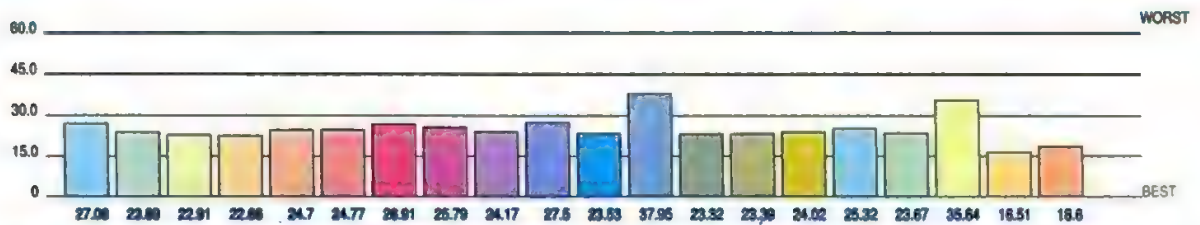
* Reported for comparison.

PORTABLES 286-BASED

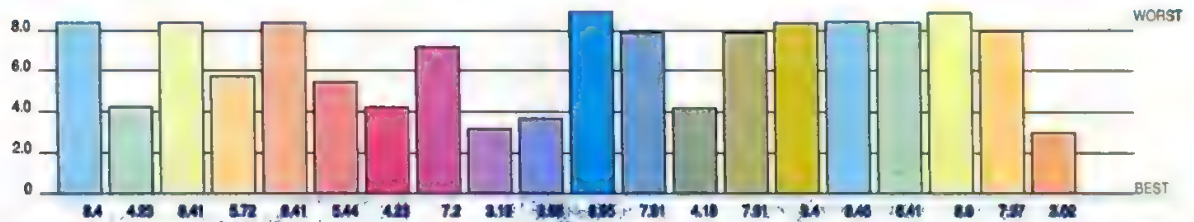
Elapsed Time (seconds)



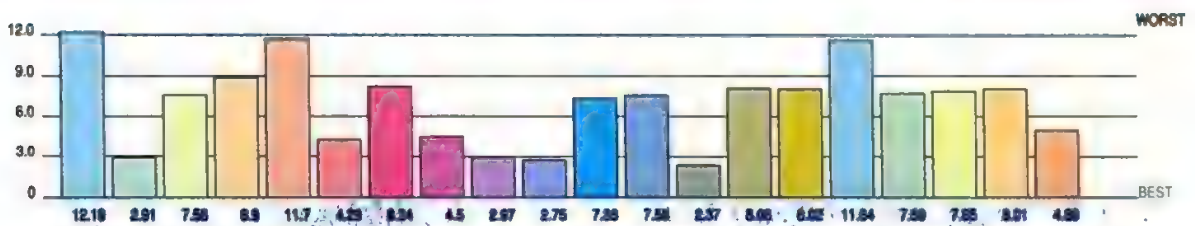
Elapsed Time (milliseconds)



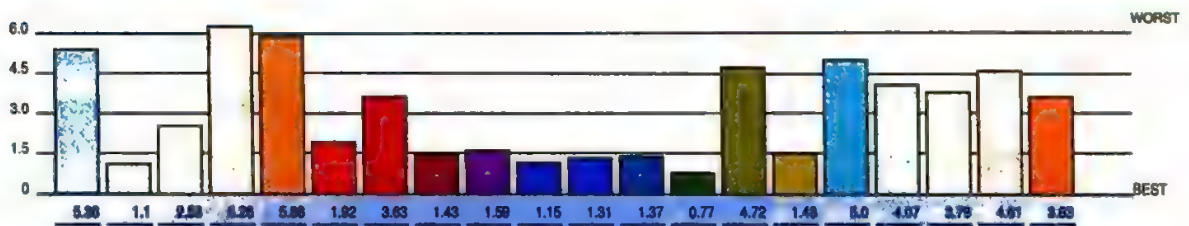
Elapsed Time (seconds)



Elapsed Time (seconds)



Elapsed Time (seconds)



UNICOM Laptop 286-12 (12 MHz)
Zenith SuperPort 286 (12 MHz)
Packard Bell P8288LP (12 MHz)
Atache Ninja 12 VGA (12 MHz)
Dolch P.A.C. 286-12 (12 MHz)
Mitsubishi PC III 286 (12 MHz)
Dauphin Laptop-286 (12 MHz)
Tandon LT/286 (12 MHz)
NEC PowerMate Portable Plus (12 MHz)
NEC PowerMate 286 (12 MHz)
Sundown B310 (12 MHz)
K288 TL-3240EL (12 MHz)
DynaBook 286 (16 MHz)
Naima Express Lite-Sys 3400 (16 MHz)
Naima One (16 MHz)
Dolch P.A.C. 286-16 (16 MHz)
Data World Portacom II 286-16 (16 MHz)
Blue Max Atache 286 (20 MHz)
Micro Express Regal 286 (20 MHz)
PC Brand Portable PC III 286/20 (20 MHz)

CONTINUES

PORTABLES 286-BASED

45, which came with a \$599 optional 2,400-bit-per-second internal modem.

Our review of the TravelMate's display shows good points and bad. With a top resolution of 640 by 480 and 8 shades of gray, the backlit black-on-white display supports VGA graphics. Our evaluation unit did a nice job of translating our 16-color VGA and 8-color EGA images. Unfortunately, while the graphics capability seems up to par, overall image quality is poor. The display appears washed out, and slight inconsistencies in brightness across the

screen compound the problem, making some images seem blotchy.

The keyboard, too, gets mixed ratings. On one hand, the keyboard feels good, thanks to the full-sized keys and the same key travel you'd expect with a standard, desktop keyboard. On the other hand, the keyboard's layout presents problems. For instance, the Insert and Delete keys rest on the top row of the keyboard, to the right of the function keys, making their use awk-

ward for heavy word processors.

The battery pack, a plastic-encased bundle of batteries rather than a cartridge, sits in a compartment that opens to the top of the machine located near the back-left corner. To remove it, you must remove two screws from the compartment lid, remove the lid, then unplug the battery wires from their plastic connector. This isn't terribly convenient for switching battery packs on the fly. The battery bundle itself weighs nearly 2 pounds, placing it among the heaviest of the battery-powered units



PROCESSOR, MEMORY, AND DISK BENCHMARK TESTS: COMPOSITE VIEW

All the portable 80286-based computers in our review far outperformed the original 8-MHz IBM PC AT, even though a few of these systems weigh only 7 pounds with a hard disk (the Compaq LTE/286 and Texas Instruments' TravelMate LT286 Model 12). Most of the reviewed products are rated at 12 MHz, but the tested field runs the gamut from a 10-MHz Hyundai to three 20-MHz units from International Instrumentation (the Blue Max Attache 286), Micro Express, and PC Brand.

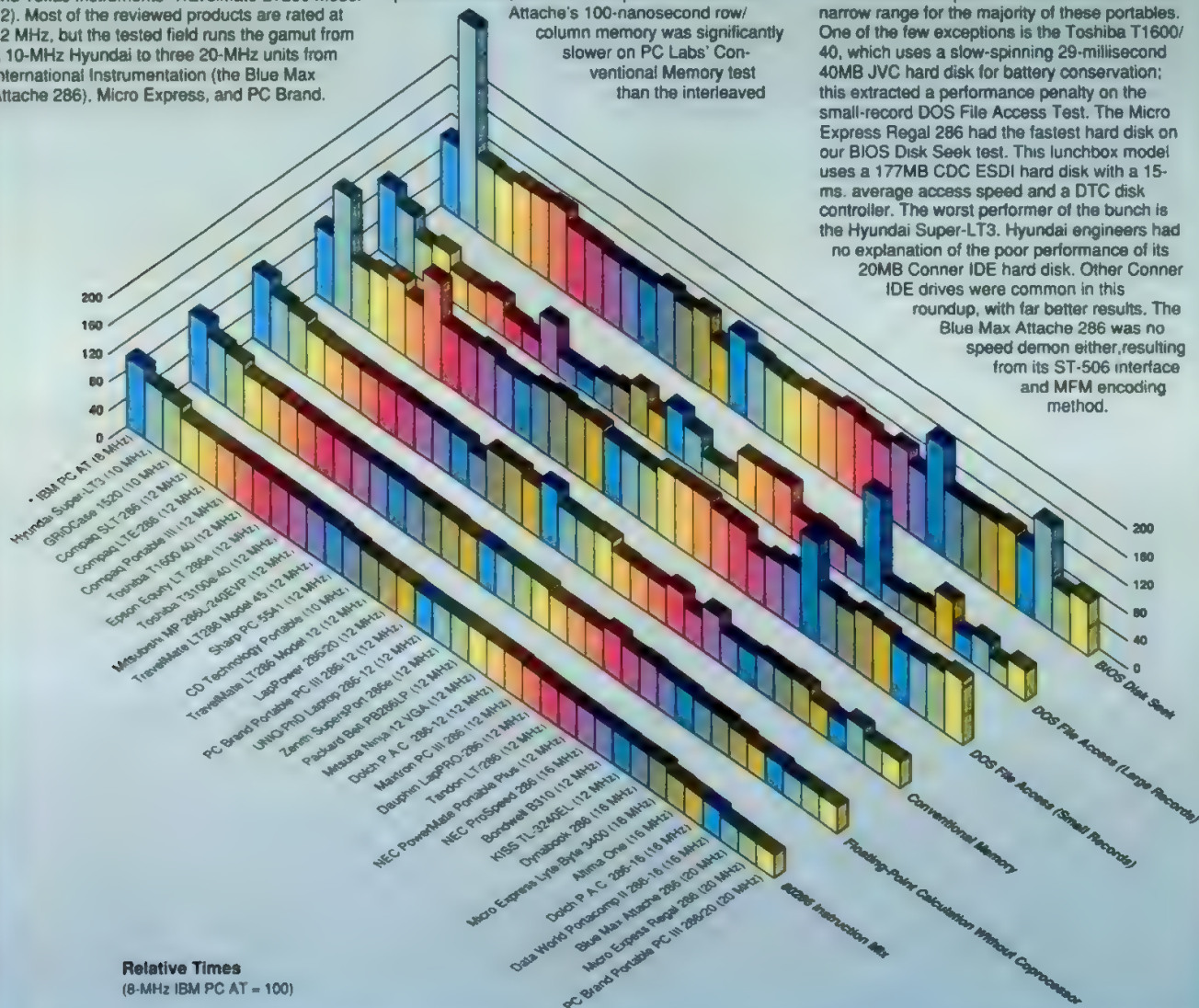
While none of these three 20-MHz portables are battery-powered, nineteen of the thirty-five reviewed systems are.

The three 80286/20 portables in this review performed comparably on our memory and processor tests, with one exception: the Blue Max Attache's 100-nanosecond row/column memory was significantly slower on PC Labs' Conventional Memory test than the interleaved

memory of the Micro Express and the PC Brand. NEC's 12-MHz PowerMate Portable Plus outperformed its 16-MHz sibling, the ProSpeed 286, largely because it uses 80-ns. rather than 100-ns. memory.

The hard disk performance times fall within a narrow range for the majority of these portables. One of the few exceptions is the Toshiba T1600/40, which uses a slow-spinning 29-millisecond 40MB JVC hard disk for battery conservation; this extracted a performance penalty on the small-record DOS File Access Test. The Micro Express Regal 286 had the fastest hard disk on our BIOS Disk Seek test. This lunchbox model uses a 177MB CDC ESDI hard disk with a 15-ms. average access speed and a DTC disk controller. The worst performer of the bunch is the Hyundai Super-LT3. Hyundai engineers had no explanation of the poor performance of its 20MB Conner IDE hard disk. Other Conner IDE drives were common in this

roundup, with far better results. The Blue Max Attache 286 was no speed demon either, resulting from its ST-506 interface and MFM encoding method.



CONTINUES

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AD CODE 11B52

PORTABLES

286-BASED

that are reviewed in this section.

Our Model 45 averaged a respectable—if not spectacular—1 hour and 40 minutes on the PC Labs battery rundown test. Using TI's battery conservation features, which were disabled during the run-down test, you can expect another half hour or more of battery life, depending on your application. The machine conserves power by shutting down screen backlighting and/or the hard disk after user-selectable intervals of inactivity. The TravelMate also automatically reduces its clock speed to 6 MHz when the processor has been inactive for a certain period of time.

In a rather unusual touch, TI dedicates one key on the keyboard to the CMOS setup utility. This can be somewhat disconcerting when you accidentally hit the key and find yourself staring at the system's

setup utility. On the other hand, it allows you to change the display and hard disk shutdown inactivity periods on demand.

The TravelMate accommodates a maximum of 3.6MB RAM—the standard motherboard allotment of 640K plus 3MB of additional RAM via an option slot. The option slot accepts TI's 1MB EMS/Extended RAM card, which in turn accepts an additional 2MB RAM module.

All in all, the TravelMate LT286 Models 25 and 45 are competent laptops. Unfortunately, the lackluster screen and poorly engineered battery pack design weigh heavily against them. The machines fail to offer any significant advantage over the most capable of the competition. The overall impression is one of mediocrity, and in

a market so laden with choices, mediocre simply isn't good enough.

TOSHIBA AMERICA INFORMATION SYSTEMS INC.

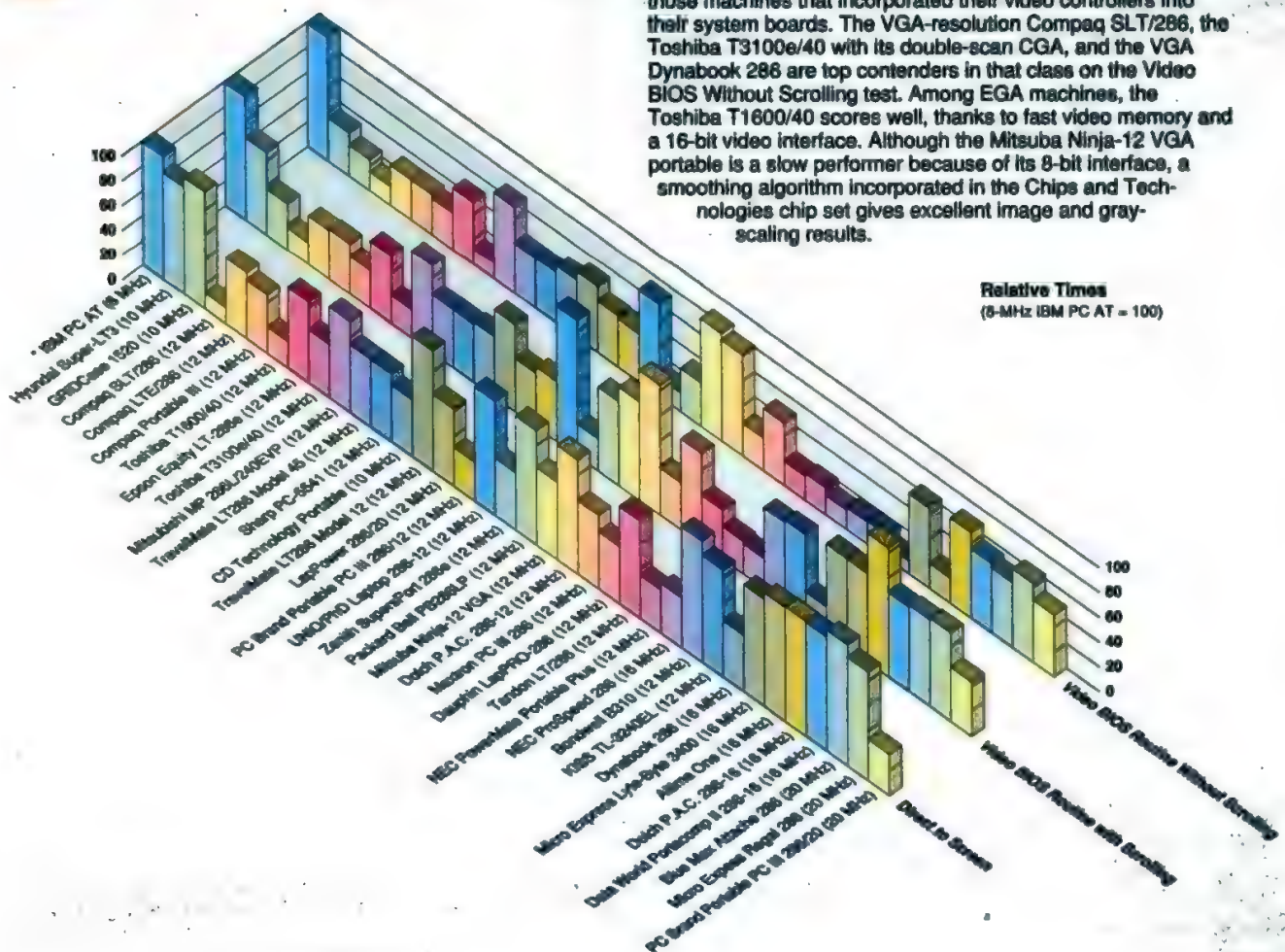
Toshiba T1600/40

by Catherine D. Miller

The T1600/40 is Toshiba's lightweight entry in the battery-powered 286 laptop market. Our \$5,268 evaluation unit came with 1MB RAM, one 1.44MB 3.5-inch floppy disk drive, a 40MB disk, two battery packs, an AC adapter, DOS 4.01, and PC Kwik Power Pak. With the exception of one battery pack, all these items are included in the basic \$5,199 unit. Since Toshiba sells through dealers and distribu-



VIDEO BENCHMARK TESTS: COMPOSITE VIEW



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MAN LOSES HAIR WAITING FOR DOS

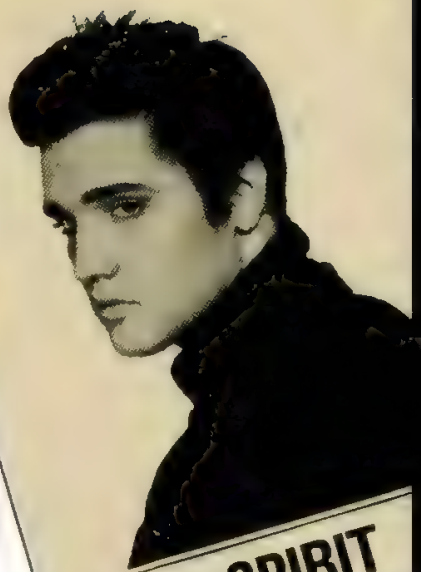
Anytown, USA—The unidentified victim was apparently among the millions of people who still think that DOS Backup and Copy commands are a safe and convenient way to back up their valuable hard disk data. It is not known whether the shocking loss was a result of natural aging while DOS made the backup, or whether the victim pulled his hair out in frustration after discovering that a minor disk error had rendered his entire backup set useless.

According to reliable sources, the tragedy could have been averted if the man had been using **FASTBACK PLUS**, the world's fastest and most reliable backup software.

A special commission has been appointed to study ways in which the public can be made aware that **FASTBACK PLUS'** Advanced Error Correction, easy-to-use menu, flexible file and directory selection, automated backup options and other features allow even beginners to make fast, foolproof backups.

Public knowledge of these facts could ease the wide-spread stress and trauma that result from using DOS commands to back up hard disk data.

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dable 9600 you've ever seen.



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PORTABLES 286-BASED

tors, the selling price should be significantly less.

Alps manufactures the 86-key keyboard which is built into the compact 3.25-by 12.25-by 12.75-inch (HWD) clamshell case. Pleasant to type on and intelligently arranged, standard-spaced keys are placed in a slightly altered standard AT layout. Twelve function keys are ordered above the numeric keys, and eight separate cursor control keys are arrayed around the right side. The numeric keypad is embedded, but a separate 17-key numeric keypad is available for \$99.

Two battery-pack bays reside under the keyboard beneath the unit's handle. The T1600/40 weighs about 12.5 pounds with one battery pack installed; add another pound for the second battery pack. Although the nickel cadmium batteries are fairly light and compact, they don't give you much operation time. The T1600/40's results on our battery rundown tests showed that a single battery is good for a little over an hour's operation.

With limited battery life, battery conservation techniques become very important. You can set the automatic display-off feature to stop supplying power to the backlit LCD's electroluminescent back panel after 3 to 21 minutes in 3-minute intervals; the hard disk drive, in 5-minute intervals; and the CPU when it's not being used. One of the more exciting features made possible by low-power CMOS technology is auto-resume capability, which

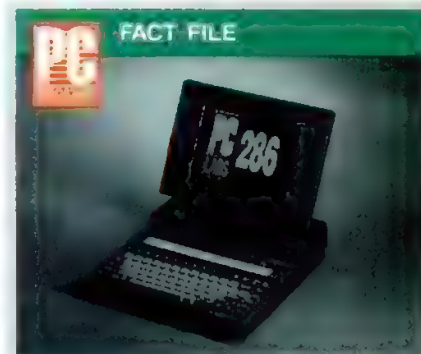
allows you to turn the unit's power off and return to the same place in an application when you next power up.

The quality of the 16-gray-scale graphics is acceptable, but an aspect ratio of 1.62 and some streaming in the display mar the overall graphics image. The detachable backlit EGA LCD screen can be replaced with a \$695 reflective supertwist EGA LCD screen designed to increase the T1600/40's battery life.

Many of the internals are built by Toshiba. Centered around an 80C286-12 processor, Toshiba's motherboard supports a maximum of 5MB, which can be purchased as 2MB memory modules, and includes a socket supporting a 12-MHz 80C287 math coprocessor. The 12-MHz unit runs at one wait state, using 1MB of 100-nanosecond DIP-style memory chips. The Award BIOS supports video—but not system—BIOS shadowing, and password protection is not included in ROM.

The T1600's performance on our benchmark tests was mixed. Processor and memory test scores were slower than average, and fast video times were offset by slow disk times. Toshiba does include *PC Kwik Power Pak's* disk-caching software to improve hard disk performance.

At 12.6 pounds with one battery pack, this machine is lighter than some 286-based laptops but outweighs many contenders. Although the T1600/40 bears the quality of Toshiba's solid design and construction, mediocre performance and limited battery life may lead one to look elsewhere in the Toshiba line for a high-performance battery-powered laptop. Take a look at the 80386SX-based T3100SX, which lists for about \$700 higher, weighs a little over a pound more, comes with a VGA gas plasma screen, and has longer battery life.



Toshiba T3100e/40
Toshiba America Information Systems Inc.,
Computer Systems Div., 9740 Irvine Blvd., Irvine,
CA 92718; (800) 334-3445, (714) 583-3000.
List Price: With 1MB RAM, 40MB hard disk, one
1.44MB 3.5-inch floppy disk drive, CGA gas
plasma display, DOS 4.01, *PC Kwik* utilities,
\$4,299.
In Short: An AC-powered laptop weighing 13.4
pounds (including power cord), Toshiba's lowest-
priced 286 portable offers modest expansion
capabilities, a fast hard disk and video, and
crisp—albeit CGA—graphics.

CIRCLE 623 ON READER SERVICE CARD

powered clamshell portables.

Our \$4,299 evaluation unit included 1MB RAM, one 1.44MB floppy disk drive, a 40MB hard disk, a CGA gas plasma display, one parallel and two serial ports, DOS 4.01 and *PC Kwik* disk caching software.

Toshiba markets this machine as a lightweight portable offering desktop performance. Based on an 80286 running at either 6 or 12 MHz, the motherboard came standard with 1MB of 85-nanosecond surface-mounted DRAM in a row/column memory configuration. Two additional memory modules can be added to the board in \$1,299 2MB or \$399 512K increments, for a maximum of 5MB. The board also supports an 8-MHz 80287 numeric coprocessor.

An internal expansion slot, easily accessed from the rear of the unit by removing a small metal cover, is intended to serve several purposes. It functions as both a standard half-length 8-bit slot and as a proprietary Toshiba 16-bit slot. This is where you'd install Toshiba's \$399 2,400-bit-per-second modem, the \$699 10-MHz Ethernet card, or the \$199 external expansion chassis interface card. (You'll then pay an additional \$999 for the expansion chassis with five 8-bit slots.) You can only use one of these options at a time, although it's a simple matter to exchange cards when you require different functionality.

The front of the built-in 82-key keyboard is slightly raised so that when the



Toshiba T1600/40
Toshiba America Information Systems Inc.,
Computer Systems Div., 9740 Irvine Blvd., Irvine,
CA 92718; (800) 334-3445, (714) 583-3000.
List Price: With 1MB RAM, 40MB hard disk,
1.44MB 3.5-inch floppy disk drive, EGA liquid
crystal display, DOS 4.01, *PC Kwik* utilities,
\$5,199; with extra battery pack, \$5,268.
In Short: Toshiba's relatively lightweight, battery-
powered T1600 40 laptop is overshadowed by
other similarly priced and more capable models
in Toshiba's own laptop line, such as the
T3100SX.

CIRCLE 622 ON READER SERVICE CARD

TOSHIBA AMERICA INFORMATION SYSTEMS INC.

Toshiba T3100e/40

by Catherine D. Miller

A new rendition of the old favorite T3100, Toshiba's T3100e/40 is a lightweight alternative for those looking for a portable office machine. At 13.4 pounds, including a power cord, this sleekly styled 14-by 12-by 3.2-inch (HWD) laptop competes with 286-based luggables and a handful of AC-

PORTABLES 286-BASED

T3100e/40 rests on the handle in the rear of the machine, the keys are at a comfortable typing angle. Ten function keys span across the top of the keyboard, and eight cursor-control keys run along the lower-right corner. The keyboard was laid out in a thoughtful manner and is pleasant to type on, with a light, clicky feel. An optional external 15-key numeric keypad, \$99, plugs into a port on the right side.

The T3100e/40's 7.75- by 14.75-inch (width by height) double-scan CGA gas plasma display has a maximum resolution of 640 by 400. Although CGA graphics are passé, a 1.33 aspect ratio and good contrast create a better-looking display than one would expect of CGA. Even with no screen controls to adjust contrast or brightness, the screen is sharp and clear.

One of the 9-pin serial ports is located in the rear of the T3100e/40, next to the 25-pin parallel port and the external 9-pin monitor port. The video port is CGA com-

patible, supporting a color CGA monitor; you'll be looking at a CGA display whether or not you decide to use an external monitor. The second 9-pin serial port is located on the left side of the unit, just above the floppy disk drive.

The T3100e/40's performance on the PC Labs processor and memory tests was slower than most in this class. But its times on the PC Labs video tests and disk performance tests were well ahead of the pack.

The T3100e/40 offers modest internal expansion possibilities in a high-quality streamlined package, with fast video and a speedy hard disk. Although we'd like to see a VGA display option, the CGA graphics were crisp. If you want 286 performance and don't need a battery, this is Toshiba's lightweight and low-cost alternative.

UNIQ TECHNOLOGY INC.

UNIQ/PhD Laptop 286-12

by M. David Stone

Despite its name, the UNIQ/PhD Laptop 286-12 is not really a laptop computer. Measuring 13.8 by 12.25 by 13.8 inches (HWD), the unit is a bit large for a laptop designation. More limiting is the AC-only power supply, which makes the system impossible to use in such laptop situations as sitting in an airplane.

This 12-MHZ 286 system is better thought of as a reasonably portable, 16.9-pound clamshell design. The base \$2,495 configuration comes with a 640 by 400 CGA gas plasma display, 1MB RAM, a 1.44MB 3.5 inch floppy drive, and a 20MB hard disk. With DOS, the system is



PERFORMANCE TESTS: 286-BASED PORTABLES

Of the 36 80286-based portables that we reviewed in this issue, 19 were battery-operated. Battery life ranged from 21 minutes for the KISS TL-3240EL (with a 12-hour recharge) to about 220 minutes of battery operation for the Zenith SupersPort 286e and the Compaq LTE/286 notebook computer (with 8-hour charges).

The KISS underutilizes a 12V 3.6-Amp/hour lead acid battery to attain an operating time of only 21 minutes. Technical experts at KISS Computer Corp. could not explain why the system consumed so much power.

The Compaq LTE/286 uses a lightweight high-output 4.8V 5.0Ah nickel cadmium battery to achieve its impressive stamina. Zenith takes a slightly larger approach. The SupersPort 286e is equipped with a removable, external 12V 4.0Ah battery that lasted 3 hours and 42 minutes.

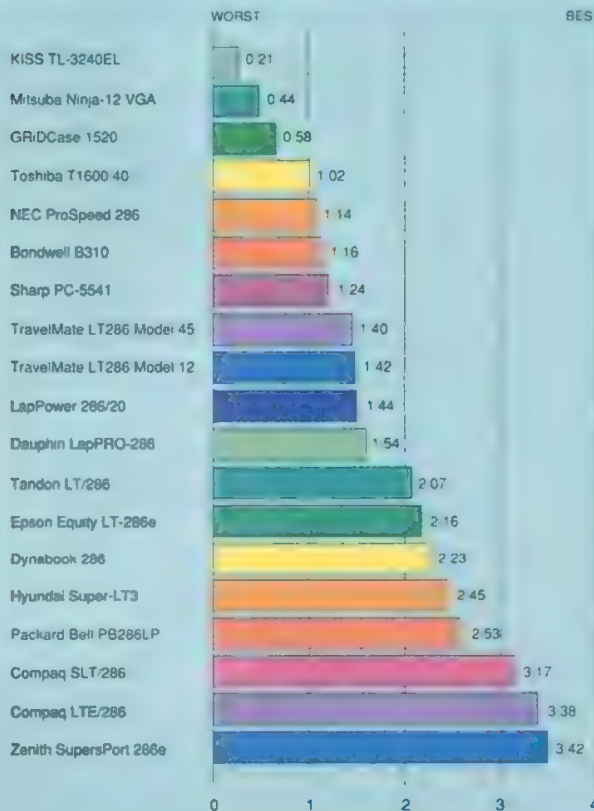
The Compaq SLT/286 is also impressive, with its VGA backlit display, a quick 90-minute charge time, and significant battery conservation technology.

Although the Sharp PC-5541 and Texas Instruments' TravelMate LT286 Model 45 are almost identical, the TravelMate ran for an additional 16 minutes because its battery has room for 0.3 Amp more.

The **Battery Rundown** performance test involves teletyping five screens of text to the laptop computer's display, then writing a 15K file to the hard disk once every minute until the battery runs out of power. All power conservation techniques are disabled.

BATTERY RUNDOWN

Elapsed Time (hours:minutes)

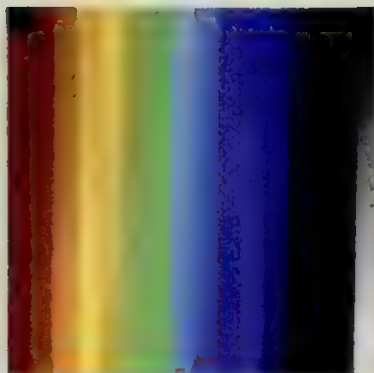


Most VGA monitors this colorful,



Image created on the Samsung VGA-GraphicMaster™ color monitor using RIX Softworks, Inc. Software
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- Improved alternate math library for faster math operations without a math co-processor.

Benchmark	Microsoft BASIC	Microsoft QuickBASIC	Borland [®] Turbo Pascal [®]
SAVAGE	129.1	449.9	281.0
FILE I/O	49.7	72.8	51.5
HAT	183.8	568.5	303.8
SCREEN	2.4	4.3	15.8
Matrix Ops	13.2	66.2	56.5
QuickSort	1.6	2.5	2.3
4P CALLS	0.3	1.0	0.6

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PORTABLES

286-BASED

\$2,595. The unit sent for review had the maximum 8MB RAM, a 45MB hard disk, a 2,400-bit-per-second modem, an external 1.2MB 5.25-inch drive, and a list price of \$3,985. As tested, the system came with DOS 3.3, though DOS 4.01 is available at the same price.

The 286-12 comes with several unexpected extras. In particular, there is the external numeric keypad included in the base price of the unit. Also standard is a chassis for the external half-height 5.25-inch drive. For \$100 more, you get the floppy disk drive as well. A nice touch is that the drive does not require a separate power supply.

On the back of the computer, you'll find one parallel port, two serial ports, and a port for a CGA monitor. Other connectors are available for the floppy disk drive, numeric keypad, and for a standard AT keyboard. The combination of an external floppy disk drive, monitor, and keyboard offers some potential for using the system as both a desktop computer and a portable. However, the CGA-level resolution and lack of an expansion chassis put severe limits on that potential.

One other notable feature is the 8-bit

slot in an easily accessible compartment. In the review system, the slot was filled with the 2,400-bps modem already mentioned, but it will take any standard card that will fit in a short slot, including, for example, a network card or fax card.

The physical design of the UNIQ/PhD Laptop 286-12 is modeled after the Toshiba T5100. In fact, the two are similar right down to the keyboard layout. However, the UNIQ system is a little higher than the Toshiba and the keyboard is tilted to make for a noticeably longer reach.

Inside the box, you'll find a Nan Tan Computer Co. motherboard with a Chips and Technologies chip set, Phoenix BIOS, and Yamaha video chips. There is also a socket for a 10-MHz 80287, which UNIQ will sell you for \$250. The 8MB of RAM on the review system consisted of eight SIP modules of 1 megabit each. According to UNIQ, these normally use 80-nanosecond chips, though the review unit included both 80-ns. and 70-ns. modules.

Be aware that UNIQ also sells a lunch-box configuration and a large-size luggage (similar to the original Compaq) for both 286 and 386 machines. However, UNIQ did not supply a 386 system in time for this review.

Clearly, the UNIQ/PhD Laptop 286-12 is a budget system. The 12-MHz 286 performance is decidedly entry level by today's standards, and the CGA display has obvious limitations for graphics. However, the display offers good brightness and contrast, making it an excellent choice for text-based programs. And the 12-MHz 286 performance may be an acceptable compromise if you need a budget solution—particularly if you need one computer that you can use as both a portable and desktop system.



UNIQ/PhD Laptop 286-12

UNIQ Technology Inc., 165D New Boston St., Woburn, MA 01801; (508) 746-7000, (617) 935-7150

List Price: With 1MB RAM, 20MB hard disk, 1.44MB 3.5-inch floppy disk drive, CGA gas plasma display, one parallel, two serial ports, external numeric keypad, chassis for external half-height 5.25-inch drive, \$2,495; with DOS 3.3 or 4.01, \$2,595; with 8MB RAM, 45MB hard disk, external 1.2MB 5.25-inch floppy disk drive, 2,400-bps modem, \$3,985.

In Short: The AC-only, 12-MHz UNIQ/PhD Laptop 286-12 may offer a good compromise if you're on a budget. Pluses include an external numeric keypad as standard. If you want to use it as a desktop system as well as portable, you'll find connectors for an external display and external AT keyboard. Minuses include its CGA-level display.

CIRCLE 624 ON READER SERVICE CARD

VERIDATA INC.

LapPower 286/20

by Robin Raskin

Conventional computer wisdom says a 286/20 machine has a 286 processor running at 20 MHz, right? Don't be misled: the "20" in the \$4,299 12-MHz Veridata LapPower 286/20's name stands for its built-in 20MB hard disk drive. Even so, the 286/20 offers well-designed power.

The basic system comes equipped with a 20MB Conner Peripherals hard disk drive, a 1.44MB 3.5-inch Citizen floppy disk drive, and can be configured with 1-,

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February 1989

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CIRCLE 345 ON READER SERVICE CARD

PORTABLES
286-BASED

2-, 3-, 5-, or 8MB RAM. The machine that we tested came standard with 1MB of memory configured with four 256-kilobit SIMM memory modules. The ROM-based setup program allows you to configure memory above 640K as either expanded or extended memory. The expanded memory manager utility is an emulation of LIM EMS 4.0.

With some minor exceptions, the overall design of the machine is both attractive and utilitarian. This near-14-pounder opens clamshell-style, with two side tabs that require a strong arm to release. The display has a sufficient degree of rotation to make it comfortable to work in even the most cramped airline seat. The 86-key Veridata keyboard can be released from the body of the laptop and used comfortably thanks to a generous length of cable; hinged legs tilt it up for comfortable use. An optional numeric keypad is available for \$129.

The keyboard plugs into the laptop in the front, underneath a small and annoying overhanging lip that is embossed with a function-key template. Once the keyboard is removed from the chassis, the template is a useless artifact. Wedging your fingers underneath the lip into the keyboard connector makes plugging in your keyboard feel like microsurgery.

There are two parallel ports, an RS-232

serial port, an extra AT-style keyboard connection, a connection for an external analog monitor, and a connection for a \$1,000 expansion chassis.

While the computer is reasonably lightweight, the optional add-ons buck that trend. The external 5.25-inch floppy disk drive was so heavy that I thought it was encased in steel. And although we did not receive an expansion chassis for review, I understand the unit takes after its cousin. An internal Hayes-compatible modem is available as an option. Finally, a heavy-duty nylon carrying case with ample room for a few traveling amenities is available for \$79.

The LapPower 286/20's double-supertwist LCD VGA-compatible display offers 16 levels of on-screen grays with as many as 32 levels of gray by using its auto-mapping features. As the LCD screen heated up we did spot some streaming that is slightly, but not significantly, more noticeable than in other machines in the same category.

Veridata includes a number of utilities to let you customize conservation of the machine's removable nickel cadmium battery packs. POWERCON.EXE can be installed RAM-resident to alert you with audible tones or flashing LEDs as the power runs low. There is also a standby switch. The accompanying manual does a good job of explaining battery conservation and recharging and also offers a section with advice for travelers.

You must return the machine to Veridata for all repairs. Upgrades, such as installation of a math coprocessor or a memory increase, are handled by the dealer. Machines like the Veridata can spell trouble for you if your dealer is unprepared to offer support.

The Veridata is an attractive machine that has everything we've come to demand in a quality 286-based laptop. If you're looking for 80286 power in a package you can carry away with you, give this one a look.



LapPower 286/20

Veridata Inc., 11901 Goldring Rd., Unit A + B,
Arcadia, CA 91006; (813) 303-0613.

List Price: With 1MB RAM, 20MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA liquid crystal display, AC adaptor/transformer, DR-DOS 3.41, \$4,299

In Short: Despite the fact that these guys pulled a fast one by using the "20" in the 286/20 label to refer to the size of the hard disk and not the processor speed, the 12-MHz Veridata LapPower 286/20 has everything you've come to expect in a quality 286 laptop. Most notable are the nice LCD VGA display and the variety of battery conservation techniques.

CIRCLE 625 ON READER SERVICE CARD

ZENITH DATA SYSTEMS

Zenith SupersPort 286e

by Bruce Brown

Look up all the old Zenith SupersPort 286 reviews (everything good still applies), add a superb VGA screen and \$500 to the



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PORTABLES 286-BASED

list price, and you've got the SupersPort 286e—a fine top-shelf 12-MHz 286 laptop from the people who helped make visible laptop screens a reality.

The base unit list price for the SupersPort 286e is \$5,499 including 1MB RAM, 20MB hard disk, 1.44MB 3.5-inch floppy disk drive, the new VGA supertwist LCD display, one serial and one parallel port, DOS 3.30 Plus, and ancillary utility software. Our test unit with a 40MB drive lists for \$5,999.

The SupersPort 286e's off-white case measures 3 by 12 by 12 inches (HWD). With the battery attached it weighs a hefty 16.41 pounds, 4.51 of which belongs to

the battery alone. If you don't need battery operation, just carry the 11.9-pound computer with the 1.65-pound AC adaptor.

When running on battery power, the 286e can keep going for more than 3.5 hours, beating Zenith's oft-stated design parameter of 3-plus hours for battery-operated computers. To increase battery life, you can set the system to power down the screen, hard disk drive, and ports and slow down the CPU to 6 MHz.

The big news about the 286e is the screen, of course, and it's a beauty: certainly as good LCD VGA graphics as any



EDITOR'S CHOICE

- Compaq LTE/286 (12 MHz)
- Compaq SLT/286 (12 MHz)
- Dynabook 286 (16 MHz)

Our choices among 286 portables are all battery powered. We preferred machines with superior color mapping (the ability to render colors as distinguishable shades of gray), larger VGA displays (approaching 8 by 6 inches), quick-change batteries, and intelligent power and battery designs. We chose three portables that met these criteria, plus two smaller, lighter notebook machines.

Compaq's LTE/286 is a stand-out for its compact power. At 7 pounds and 8.5 by 11 inches, the Compaq is a bit smaller and thinner than every other portable PC with internal drives. Its screen, however, is somewhat small at 8 by 4 inches, and its highest standard graphics resolution is CGA. Texas Instruments' TravelMate LT286 Model 12, \$2,000 cheaper than the Compaq LTE/286, comes with a hard disk only; the floppy disk drive is external and optional (as is the parallel port).

Among larger 286 portables, Compaq's 12-MHz SLT/286 set the standard one and a half years ago with intelligent powerdown, 3-plus hours of battery life, detachable keyboard, quick-change battery, and typically sturdy Compaq construction. At 16 pounds, it is a bit on the heavy side. The competition is catching up, but the SLT/286 remains the best all-around 286 portable you can buy.

- Mitsuba Ninja-12 VGA (12 MHz)
- TravelMate LT286 Model 12 (12 MHz)

With a modular approach to design, the sleek, matte black Dynabook 286 lets you carry just what you need. The 16-MHz Dynabook outperformed some 386SX-based systems and has one of the best VGA displays we've seen.

The Mitsuba Ninja-12 VGA is a steal at \$3,600—with a 40MB hard drive and a superior VGA display—but battery life is below average.

An honorable mention goes to the GRiDCase 1520 for its backlit LCD display, which produced the best VGA output among our 26 VGA 286 and 386 portables. It's unremarkable otherwise: cramped keyboard, weak batteries and performance, and relatively high price. However, business users will appreciate the extra ROM slots for custom applications.

What about other well-known portables? We prefer Toshiba's 386- and 386SX-based portables to the T1600-40 with its EGA display and short battery life and the AC-only T3100e/40. NEC's 16-MHz ProSpeed 286 has a big VGA screen, but it's also bulky and comparatively expensive. Zenith's SupersPort 286 has only a CGA display; the newer SupersPort 286e provides VGA for a husky surcharge. Lastly, we can't recommend any of the 286 AC-only lunchbox portables because of their generally mediocre construction.



Zenith SupersPort 286e

Zenith Data Systems, 1000 Milwaukee Ave., Glenview, IL 60025; (800) 553-0331.

List Price: With 1MB RAM, 20MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA supertwist LCD display, one parallel, one serial port, DOS 3.30 Plus, \$5,499; with 40MB hard disk, \$5,999.

In Short: Zenith's newest 286 SupersPort, called the 286e, has all of the previous version's commendable features and adds a terrific VGA screen. This is one of the machines the others have to beat.

CIRCLE 626 ON READER SERVICE CARD

I've seen. The controller produces 16 shades of gray scaling, and the aspect ratio is only a little flattened at 1.62. The screen brightness and contrast are as good as you get from any LCD screen and better than most. With this screen no one should ask you, "Is it on?"

The 286e's keyboard has 79 keys including 12 top-mounted function keys, an embedded numeric keypad accessed via NumLock or the Fn key, and a separate cursor keypad. The keyboard isn't my favorite, since my personal preference is for very heavy clicky keyswitches; however, the Zenith's softer but still clicky feel has many proponents.

The system's standard 1MB RAM can be expanded to 3MB with a pricey \$1,199 2MB upgrade. The list of options for this machine includes a \$399 external 5.25-inch 360K/1.2MB floppy disk drive, a \$449 internal 2,400-bit-per-second modem, \$499 expansion chassis with three 8-bit ISA slots, and a \$59 carrying case. There are two math coprocessor chip options, an 80287 10-MHz chip for \$525, and an 80C287 12-MHz chip for \$649. You can also buy extra batteries in three sizes.

The SupersPort 286e isn't as light as a notebook computer, nor is it a 386 chart-burner, but this classic 286 laptop with up-graded VGA mode display is widely available and darned good. I'd recommend this machine to anyone who needs a full-featured 286 laptop with good battery life. ■



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PCBRAND 286/20 _____ \$899

20 MHz Clock, Zero Wait Operation
Norton SI 23.0 Landmark™ Speed 26.7MHz
512K RAM, 1.2MB or 1.44MB Drive, 101-Key Keyboard

Standard System Features:

- 80286-12, 80286-16, 80286-20 operating at 12 MHz, 16MHz, or 20MHz w/Zero Wait States delivering 15.3MHz, 20.6 MHz, or 26.7MHz Effective Throughput
- 512K RAM expandable to 8MB on the System board using 256K or 1MB 100ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
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Hard Drives MB/MS	20/40	40/25	66/25	100/25
No Video	\$929	\$1029	\$1209	\$1349
Mono	\$1049	\$1149	\$1329	\$1469
VGA-Mono	\$1229	\$1329	\$1509	\$1649
VGA-Color	\$1459	\$1559	\$1739	\$1879
SVGA/Color	\$1569	\$1669	\$1849	\$1989

PC BRAND 286/16

w/512k, Hard Disk Drive, Monitor & Video Card

Hard Drives MB/MS	20/40	40/25	66/25	100/25
No Video	\$1079	\$1179	\$1359	\$1499
Mono	\$1199	\$1299	\$1479	\$1619
VGA-Mono	\$1379	\$1479	\$1659	\$1799
VGA-Color	\$1609	\$1709	\$1889	\$2029
SVGA/Color	\$1719	\$1819	\$1999	\$2139

PC BRAND 286/20

w/512k, Hard Disk Drive, Monitor & Video Card

Hard Drives MB/MS	20/40	40/25	66/25	100/25
No Video	\$1229	\$1329	\$1509	\$1649
Mono	\$1349	\$1449	\$1629	\$1769
VGA-Mono	\$1529	\$1629	\$1809	\$1949
VGA-Color	\$1759	\$1859	\$2039	\$2179
SVGA/Color	\$1869	\$1969	\$2149	\$2289

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*Personal Computing,
Best Bargain Systems,
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*Computer Buyer's Guide,
Cover Story, Oct, 1989*

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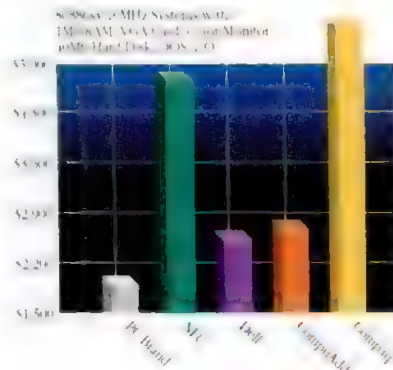
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- Real Time Clock/Calendar with 5 Year Battery
- 80387SX Co-Processor Support
- AMI BIOS with full MS DOS, OS 2, XENIX, UNIX, NOVELL, 3COM compatibility
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case w/ 6 Disk Drive bays (Shown w/ optional Mini Size Tower Case)

Options:

- Low profile Slim Line Case w/ 3 Disk Drive bays at no extra charge
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- Factory Installed RAM Upgrades
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VGA Mono	\$1,529	\$1,629	\$1,809	\$1,949
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-PC Magazine, 25MHz 386 PC's, Feb. 14, 1989

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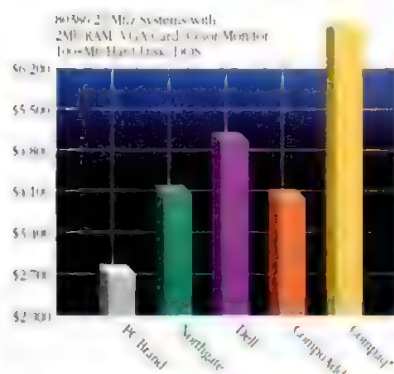
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*- PC Magazine, 25MHz 386 PC's
Feb. 14, 1989*



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- True 20MHz or 25MHzZ Intel 80386 CPU Operating with Zero Wait States
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- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with 1024x768 capability on all VGA systems
- 1:1 Interleaving Dual Hard Drive/Floppy Drive controller, 9776 KB SEC Caching Controller w/ ESDI Configurations
- Enhanced 101-key Click/Tactile Keyboard
- 2 serial & 1 parallel ports on std-configurations
- High Capacity 200Watt System Power Supply
- Real Time Clock Calendar with 5 Year Battery
- 80287, 80387, or Weitek Co-Processor Support
- AMI BIOS with full MS-DOS, OS/2, XENIX, UNIX, NOVELL, 3COM compatibility
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case w/6 Disk Drive bays (as pictured above)

Options:

- Low profile Slim-Line Case w/3 Disk Drive bays available at no extra charge
- Full Size Tower Case w/6 Disk Drive bays
- Mini Size Tower Case w/4 Disk Drive bays
- LCD or VGA Plasma Portable Case
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Mono	\$1899	\$2079	\$2219	\$2669
VGA-Mono	\$2079	\$2259	\$2399	\$2849
VGA-Color	\$2309	\$2489	\$2629	\$3079
SVGA/Color	\$2419	\$2599	\$2749	\$3189

PC BRAND 386/25

with Hard Disk Drive, Monitor & Video Card

Hard Drives:	40/25	66/25	100/25	200/19
MB, MS				
No Video	\$1929	\$2109	\$2249	\$2699
Mono	\$2049	\$2229	\$2369	\$2819
VGA-Mono	\$2229	\$2409	\$2549	\$2999
VGA-Color	\$2459	\$2639	\$2779	\$3229
SVGA/Color	\$2569	\$2749	\$2889	\$3349



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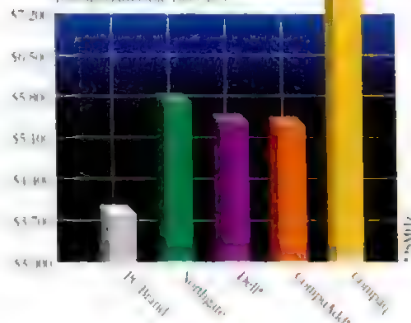
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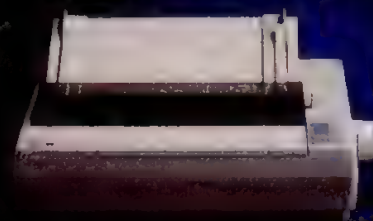
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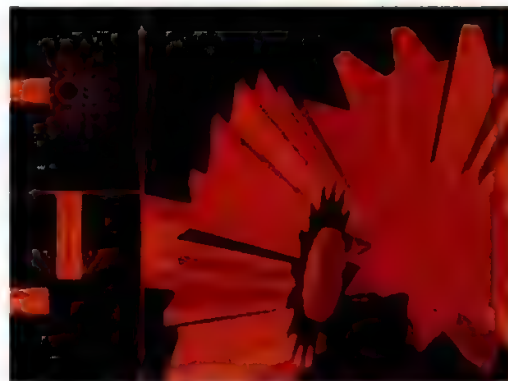
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8086/8088

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NOTEBOOKS

by Matt Ross

The lowly 8086 and 8088 processors continue to hold fast in one last stronghold of the business computing marketplace: the notebook portable. These laptop PCs fulfill our most basic computing and communications needs, are light enough to justify their low-power performance, and are becoming cheaper every day. For traveling executives in need of a light-DOS portable, look no further.

The 8086-based personal computer is a dying class. If it weren't for these notebook portables, the 8086 would be cold in its grave as a business standard; notebooks are the only 8086-based products for which significant development has continued in the last year. In the reviews that follow, the now 3-year-old Toshiba T1000 is the only portable that wasn't introduced in the last year and a half. This continued miniaturization of laptops has kept the 8086 chip out of car dashboards and elevator controls and in

the forefront of a new technology.

Back in the October 17, 1989, issue of *PC Magazine*, we reviewed 15 battery-powered 8086-based portables ("Light-weight Laptops"). In this section, *PC Magazine* chose to review only those 8086-based notebook portables that matter: machines that are battery-powered, weigh 7 pounds or less, and are actual DOS-based portables (See "The Traveling Macintosh" and "Palmtops: Tiny Containers for All Your Desktop Data," for other non-DOS laptops). These criteria left us with the Compaq LTE, NEC UltraLite, The Poqet PC, Tandy 1100 FD, Toshiba T1000 and T1000SE, and the Zenith MinisPort. Just missing the editorial deadline was the new Psion laptop, which was unavailable when these machines were being tested. Conspicuous in their absence are machines from IBM, Epson, Mitsubishi, and Sharp; these major laptop manufacturers have yet to enter the notebook market.

This triage of the XT-class results in the inclusion of only one 8086 portable with a hard disk, the Compaq LTE. The LTE is the only portable with a mechanical hard disk to meet our weight limit. The tested LTE weighs just 7 pounds with its 20MB Conner hard disk and an optional 2,400-bit-per-second modem, leaving it 3 pounds lighter than the next heaviest 8086 portable with a hard disk, the GRiDLite XL. The Compaq LTE also clearly points the direction of the notebook class. Compaq Computer Corp.'s ability to produce a 286 in the same 2- by 11- by 8.5-inch form factor demonstrates that the 8086 will probably soon be superseded by the 286 chip in its last stronghold.

But for now, these seven notebooks offer the only viable choices for light computing on the road. While the Compaq LTE features both a high-density floppy disk and its mechanical hard disk, five of the remaining six notebooks feature silicon RAMdisk storage, including the Toshiba T1000 with its optional 768K memory card. Only the Tandy 1100 FD with DOS and the *DeskMate* integrated software in read-only silicon don't have this provision.

Among the machines featuring RAMdisks as their internal storage method, you'll be much better off with the 2MB versions rather than settling for just 1MB. While this increases the price, it will also allow you to store a good integrated software package like *Microsoft Works*, *AlphaWorks*, or *PFS:First Choice* (see *PC Magazine*, December 26, 1989) or the ex-

ecutable file of your communications package in memory.

Laptop computing is about compromise, and this is especially true with notebooks. Only the Compaq LTE and the Toshiba T1000SE provide a high-density 3.5-inch floppy drive. The Tandy 1100 FD and the T1000 are limited to 720K floppy disk drives, while the Zenith MinisPort has its own 2-inch floppy disk standard, also with 720K capacity. NEC Technologies and Poqet Computer Corp. opt instead for RAM cards as their respective removable medium.

The seven 8086-based notebooks that matter are battery-powered, weigh 7 pounds or less, and run on true DOS. With them, real computing power is an arm's length away.

While software is slowly becoming available in these nonstandard forms, expect instead to download any favorite applications onto these machines. NEC, Poqet, and Zenith Data Systems all provide data transfer software, *Lap-Link*, *Poqetools*, and *FastLynx LX*, respectively. This special handling is to be expected within the notebook class. Unlike other computers, loading your favorite software might not be as easy as throwing in a diskette and typing "install."

The next major area of compromise involves the displays of these portables. While the 286- and 386-based PCs reviewed in this issue have displays as large as 9 by 6 inches, the Toshiba T1000SE has the largest display of any notebook PC at 7.5 by 4.75 inches. All seven of the notebooks that are reviewed here feature CGA as their maximum resolution, with the Poqet PC, the Tandy 1100 FD, and the Toshiba T1000 lacking backlit displays. The less-advanced CGA liquid crystal displays

are not only cheaper to produce, they are significantly thinner—a double savings for laptops.

The T1000SE and the UltraLite offer the best displays in this class, although none of these machines can handle any significant graphics work. They are strictly for character-based applications. The Zenith MinisPort—with its transreflective 8.25- by 3.25-inch display combining reflective and backlit technologies—can be used indoors or outside in daylight, unlike standard backlit displays. Whether the MinisPort's being hard to read both inside and out is more valuable is another question.

These notebook machines also lack the I/O capabilities of larger portables. Only the Compaq LTE, the Zenith MinisPort, and the Toshiba T1000 have external RGB connectors, and serial and parallel ports are frequently nonstandard or combined with an external floppy disk drive connector, making printing documents a challenge. Expansion is all but nonexistent, as none of these machines supports a docking station or expansion chassis. Internal slots are dedicated for modems and additional memory.

In addition to the computer size getting smaller, the accompanying transformers are smaller too, resulting in even lighter overall travel packages. Lightest of all is the 1-pound Poqet, with its AA batteries and no transformer. Next is the 4.5 pound NEC UltraLite, whose transformer weighs just 1.2 pounds. Of the remaining machines, which are all in the neighborhood of 6 pounds, the best light-travel package is the 6.2 pound T1000SE with its 0.65 pound transformer.

As laptops have gotten smaller, battery life has grown. Better battery technology combined with smarter, lower-power-consuming chip sets results in battery life in excess of 2 hours between charges.

There is still plenty of room for improvement in the notebook class. Only the T1000SE has an Auto Resume feature, and these machines should implement quick-charge batteries (currently only on the MinisPort, T1000SE, and Compaq LTE). All now accept modems with the exception of the Poqet, but only NEC has built a 2,400-bps modem into the system board as standard equipment.

Even with these unfulfilled wishes, notebook portables continue to shrink in size and grow in performance. And the prices are shrinking as well. The Tandy 1100 FD and the Toshiba T1000 are both

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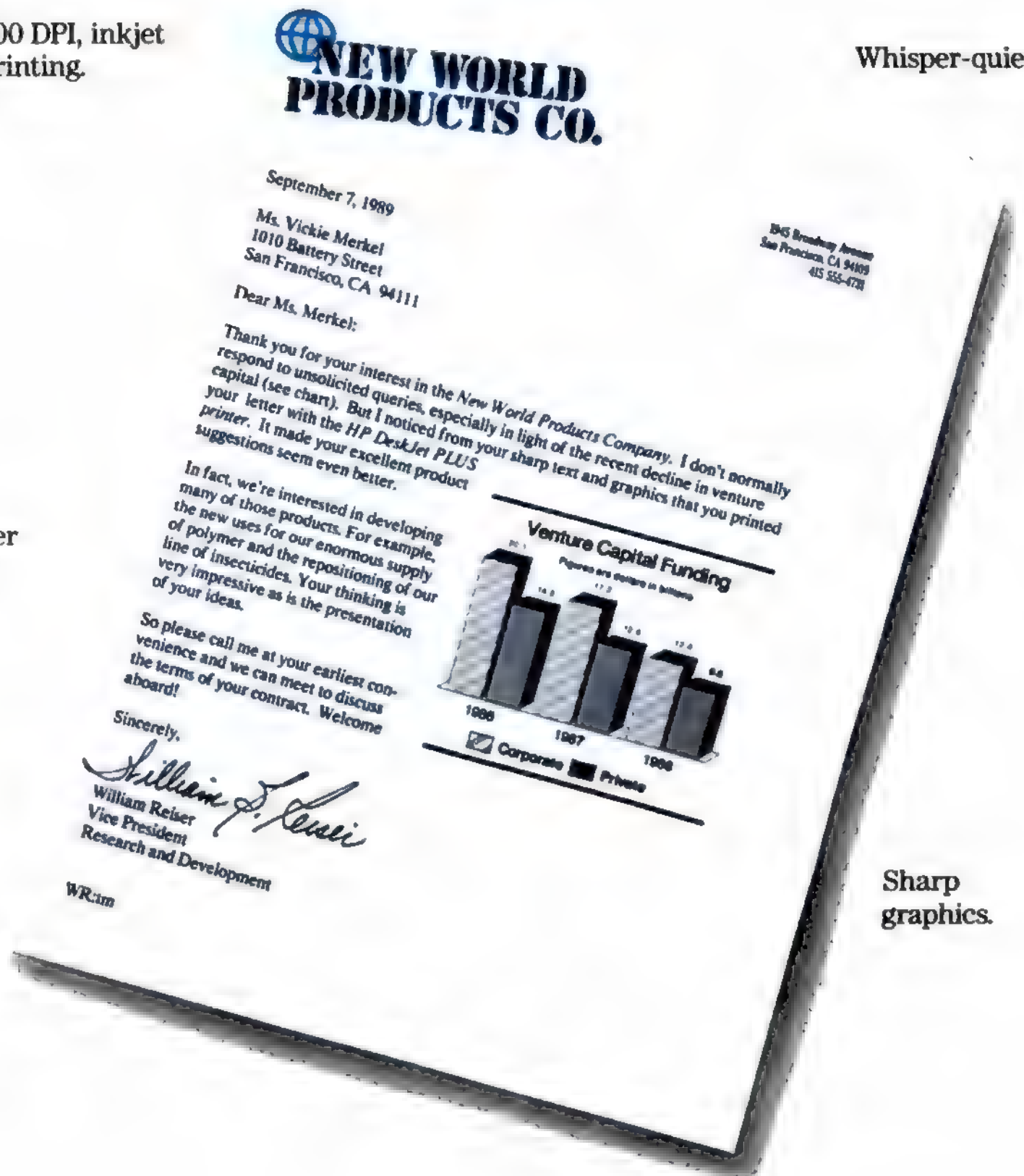
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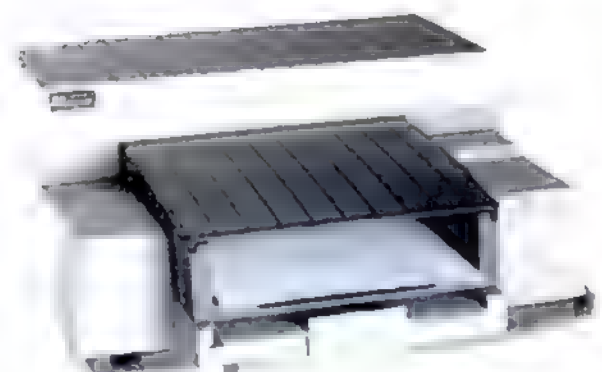
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While everybody else was deciding how big a silicon disk to tuck into their notebook portables, Compaq was busy with its own project: two notebook portables with real 20MB hard disks and standard 1.44MB 3.5-inch floppy disk drives.

The Compaq LTE/286, reviewed along with the 80286-based machines, is geared for those who need serious number-crunching power in a small machine. The 80C86-based Compaq LTE, which lists at \$3,119 with DOS 3.3 and a 20MB hard disk, comes in an identical package and with similar features to those found on the LTE/286, but costs \$1,500 less.

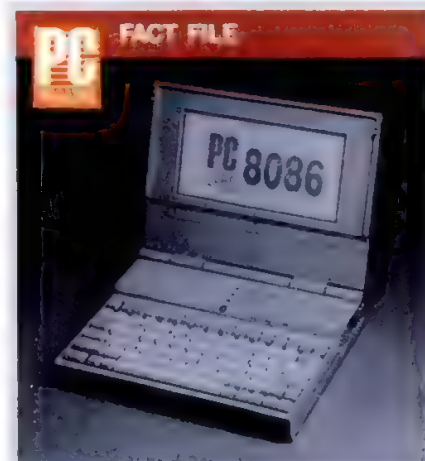
Does a hard disk make sense in an 8086-based notebook portable? Sure, as long as the penalties in size, weight, battery power, and system cost don't override the advantages. Compaq has done an excellent job of keeping those penalties to a minimum.

The LTE, which feels almost as heavy as a well-baked brick, measures a svelte 1.9 by 11 by 8.5 (HWD) inches. That's roughly comparable in size to that of the NEC UltraLite, with the exception of thickness, where the Compaq is a mere half-inch larger.

When it comes to weight, the LTE imposes a more significant penalty. The UltraLite, the lightest of the notebook crowd (excluding the palm-size Poqet), weighs in at 4.4 pounds, including its internal 2,400-bps modem. The LTE review unit we tested weighs 7.2 pounds, including its optional internal modem and 384K expanded memory board. Compaq attributes .8 pounds of the machine's weight to the Conner Peripherals hard disk, which is a 3.5-inch drive but measures only 0.75 inches high. The floppy disk drive is the same size and weight.

The biggest single weight contributor, however, is the removable, nickel cadmium battery pack at 1.5 pounds. Compaq opted for such a hefty pack to provide the generous 3.5-hour battery life for the 12-

PORTABLES 80086/8088-BASED



Compaq LTE

Compaq Computer Corp., 20555 SH 249, Houston, TX 77269-2000, (713) 370-0670.

List Price: With 640K RAM, one 1.44MB 3.5-inch floppy disk drive, CGA electroluminescent liquid crystal display, parallel port, serial port, utilities, slip case, \$2,399; with 20MB hard disk, DOS 3.31, \$3,119; with 1MB RAM, external storage module, external 1.2MB 5.25-inch floppy disk drive, 2,400-bps internal modem, carrying case, \$4,580.

In Short: The smallest 8086-based notebook machine with a hard disk, the 7-pound LTE also has a standard 3.5-inch floppy disk drive and a bright CGA display.

CIRCLE 627 ON READER SERVICE CARD

MHz LTE/286. Running at a less power-hungry 9.54 MHz and with a more power efficient processor, the LTE doesn't need such a large battery pack. However, with this battery, you can expect a battery life far longer than that offered by any of the competition. The LTE lasted over 5 hours on PC Labs' Battery Rundown test, even without any of its battery-conservation utilities. With battery conservation enabled, you'll probably enjoy a solid 6 hours or more of outlet-free operation.

The LTE's electroluminescent, backlight, supertwist LCD screen supports CGA graphics with four gray scales and a resolution of 640 by 200. Its highly readable display compares favorably with the best of the competition, namely the UltraLite and the Toshiba T100SE. One minor complaint: when using the default, near-white background, the display bleeds vertically from the deep-blue characters. The streaks are faint enough so that you can all but eliminate them by keeping the contrast carefully adjusted.

The only truly bothersome aspect of this machine concerns its keyboard. Keyboard layout suffered significantly at the hands of Compaq's space-trimming designers. While the standard alphanumeric

keys—the ones every typewriter has—are full-size and perfectly placed, some important auxiliary keys couldn't be worse.

The four arrow keys provide the most extreme example. Though located sensibly at the bottom right of the keyboard, the arrow keys form a lazy-L rather than a diamond. First comes the left arrow, then the right arrow, then the down arrow with the up arrow above. Keyboard action is hampered by a short travel distance. However, this proves easy to grow accustomed to and ultimately even likable.

All things considered, the Compaq LTE rates as an impressive, convenient, and somewhat miraculous machine. In the same way the UltraLite seemed impossible for its size a year ago, the LTE seems impossible now.

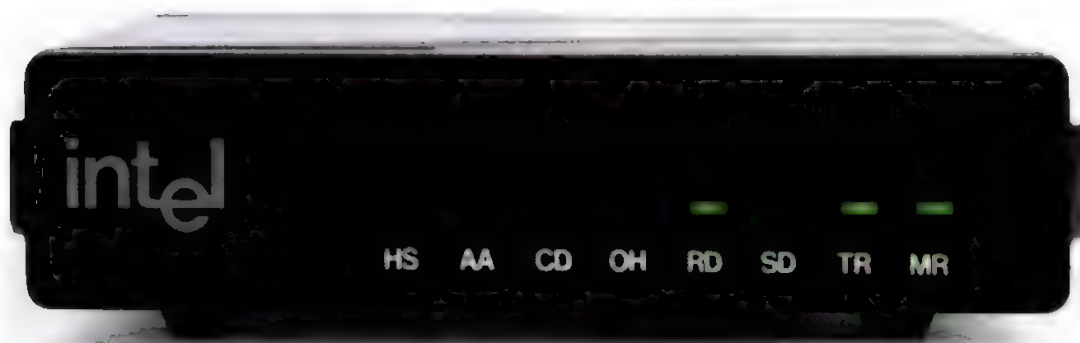
At least for the time being, this little miracle comes at a hefty price. Fully loaded with 640K RAM, 384K expanded memory, a 20MB hard disk, a 2,400-bps internal modem, carrying case, external storage module, and a 1.2MB 5.25-inch external floppy disk drive, our evaluation unit carried a list price of \$4,580. Dealers often offer Compaq systems at discounts as large as 40 percent, but Compaq reports that the initial low availability of the LTE and the LTE/286 will probably keep prices close to list for some time.



Two years ago had you asked: "What runs at 10 MHz, has a full-size keyboard, a CGA backlit LCD, runs on batteries, stores 2MB of data, weighs less than 5 pounds, and costs under \$3,000?" the answer would have been an emphatic "Nothing!" followed by the guffaws of your computer salesperson. Nowadays, you'll be steered politely over to the glass case containing the NEC UltraLite.

When it was first introduced late in 1988, this \$2,999 notebook powerhouse set the portable world on its ear. Although it lacks the bona fide hard and floppy disk drives of its heavier cousins, NEC's offering represents the best cure for the sore-shouldered business traveler. The UltraLite ships standard with either a 1MB or 2MB static RAMdisk, a built-in 2,400-bps modem, and a host of ROM-based software, including *Lap-Link* and Microsoft's *MS-DOS Manager*.

Primo modem, mini moola.



Intel MNP5 modems—they're new, they're primo, and, most importantly, they're available.

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Intel models are Hayes compatible, to get along famously with almost any software you choose. Speaking of which, each modem comes with free communications software. Plus you get a five-year warranty—the best in the industry—a toll-free technical support hotline, and of course, Intel quality.

It's a great package. The only thing skimpy about it, in fact, is the price: Each Intel modem costs less than half the price of a comparable Hayes unit. That may be too little to pay for a premium modem but, as we said, we tried. Make the most of it.

Call (800)538-3373 for the Intel retailer nearest you; to have product literature faxed directly to you, call (503)629-7576 and ask for Document #9987.

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FEATURE	IBM® PS/2 MOD 50Z	IBM® PS/2 MOD 55SX	TELEVIDEO TELE386SX¹	COMPAQ® DESKPRO 286e	COMPAQ DESKPRO 386S²
CPU	80286	80386SX*	80386SX	80286	80386SX
Speed	10 MHz	16 MHz	16 MHz	12 MHz	16 MHz
Wait State	0	0	0	1	0
Std Memory	1 MB	2 MB	1 MB	1 MB	1 MB
32-Bit Software Compatible	NO	YES	YES	NO	YES
On-Board Video	VGA	VGA	VGA	VGA	VGA
Monitor	OPTION	OPTION	OPTION	OPTION	OPTION
Fixed Disk	30 MB	30 MB	OPTION	OPTION	OPTION
Price	\$3250	\$3850	\$2339	\$2699	\$3299

Note: Information on this chart is based on published materials.

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8086- AND 8088-BASED PORTABLES: SUMMARY OF FEATURES



	Compaq LTE	NEC UltraLite	The Poqet PC	Tandy 1100 FD	Toshiba T1000	Toshiba T1000SE	Zenith MinisPort
TESTED CONFIGURATION							
Price	\$4,580	\$3,398	\$1,995	\$999	\$1,398	\$2,398	\$3,515
Microprocessor	9.54-MHz 80C86	9.83-MHz V30	7-MHz 80C88	8-MHz V20	4.77-MHz 8088	9.54-MHz 8086	8-MHz 80C88
Power supply type	Battery	Battery	Battery	Battery	Battery	Battery	Battery
Case type	Notebook	Notebook	Palmtop	Notebook	Notebook	Notebook	Notebook
Dimensions (HWD, in inches)	1.9 x 11 x 8.5	1.5 x 11.75 x 8.5	1.25 x 11.75 x 4.25	2.5 x 12 x 9.75	2 x 12 x 11	1.75 x 11.75 x 10	1.3 x 12.4 x 9.8
Weight (lbs.)	7	4.4	1	6.3	6.2	6.2	5.9
Display system	CGA	CGA	CGA	CGA	CGA	Double-scan CGA	CGA
Display technology	Electroluminescent LCD	LCD	Nonbacklit LCD	Nonbacklit LCD	Nonbacklit LCD	LCD	Transflective LCD
Maximum resolution (pixels)	640 x 200	640 x 200	640 x 200	640 x 200	640 x 200	640 x 200	640 x 200
Motherboard manufacturer	Compaq	NEC	Poqet	Tandy	Toshiba	Toshiba	Zenith
Chip set manufacturer	Chips and Technologies	NEC	Poqet	Tandy	Toshiba	Toshiba	Chips and Technologies
Wait states	Less than 1	0	Up to 3	1	0	1	0
MOTHERBOARD MEMORY							
Installed RAM	640K	640K	512K	640K	512K	1MB	1MB
Maximum installable RAM	640K	640K	512K	640K	512K	1MB	1MB
RAM packaging and rated speed	DIP (100 ns.)	DIP (100 ns.)	DIP (120 ns.)	SIP (100 ns.)	DIP (100 ns.)	DIP (100 ns.)	DIP (100 ns.)
Chip size	64Kb, 256Kb	256Kb	256Kb	4 x 64Kb, 4 x 256Kb	256Kb	1Mb	1Mb
ADD-IN MEMORY BOARD							
Installed RAM	384K	2MB	N/A	N/A	768K	2MB	1MB
Maximum installable RAM	384K	2MB	N/A	N/A	768K	2MB	1MB
RAM packaging and rated speed	DIP (100 ns.)	DIP (60 ns.)	N/A	N/A	DIP (100 ns.)	Silicon RAM card (100 ns.)	SIP (100 ns.)
Chip size	256Kb	1Mb	N/A	N/A	256Kb	267Kb	1Mb
BIOS							
BIOS version and date	Compaq C.3 (September 1989)	Phoenix 2.52 (January 1989)	Poqet 1.0 (1989)	Phoenix 1.00.00 (September 1989)	Award (February 1988)	Award 1.0 (September 1989)	Zenith 3.3E (1989)
Password in ROM	■	□	□	□	□	□	■
HARD DISK							
Manufacturer	Conner	N/A	N/A	N/A	N/A	N/A	N/A
Disk capacity	20MB	N/A	N/A	N/A	N/A	N/A	N/A
Interface	ST-506	N/A	N/A	N/A	N/A	N/A	N/A
Average access time (milliseconds)	29	N/A	N/A	N/A	N/A	N/A	N/A
Controller manufacturer	Conner	N/A	N/A	N/A	N/A	N/A	N/A
Hard disk options	None	N/A	N/A	N/A	N/A	N/A	N/A
INTERNAL FLOPPY DISK DRIVE							
Capacity	1.44MB	N/A	N/A	720K	720K	1.44MB	720K
Size	3.5-inch	N/A	N/A	3.5-inch	3.5-inch	3.5-inch	2-inch
Manufacturer	Citizen	N/A	N/A	Tandy	Toshiba	Citizen	Zenith
EXPANSION							
Bus speeds (MHz)	8	4.92, 9.83	Up to 7	8	4.77	9.54	8
Expansion slots	One dedicated modem slot, one memory slot	One RAM card slot	Two RAM card slots	None	One dedicated modem slot, one memory slot	One dedicated modem slot, one RAM card slot	One dedicated modem slot, one memory slot
Available slots	1	1	2	N/A	None	None	None
Drive bays	2 half-height	None	None	1 half-height	1 half-height	1 half-height	One 2-inch

■—Editor's Choice ■—Yes □—No

N/A—Not applicable: the product does not have this feature.

CONTINUES



8086- AND 8088-BASED PORTABLES: SUMMARY OF FEATURES

	Compaq LTE	NEC UltraLite	The Poqet PC	Tandy 1100 FD	Toshiba T1000	Toshiba T1000SE	Zenith MinisPort
VIDEO							
Display circuitry location	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard
Interface	8-bit	8-bit	8-bit	8-bit	8-bit	16-bit	8-bit
Chip set manufacturer	Compaq	NEC	Poqet	Tandy	Toshiba	Toshiba	Chips and Technologies
Video modes supported	CGA, MDA	CGA, MDA	CGA, MDA	CGA, MDA	CGA, MDA	CGA, MDA	CGA, MDA
Viewable area (WxH, in inches)	7.7 x 3.7	8.25 x 4.25	6.75 x 2.25	7.38 x 4.75	9.5 x 2.9	7.5 x 4.75	8.25 x 3.25
External monitor support	■	□	□	□	■	□	■
KEYBOARD							
Number of keys	81	78	77	84	82	82	80
Number of function keys	10	12	12	12	10	12	12
SOFTWARE							
Software in ROM	None	DOS 3.3, <i>Lap-Link,</i> <i>MS-DOS Manager</i>	DOS 3.3, <i>Poqetools</i> utilities	DOS 3.3, <i>DeskMate,</i> <i>PC-Link</i>	DOS 2.11	DOS 3.3	DOS 3.3, <i>FastLynx LX</i>
PHYSICAL FEATURES							
Case lock	None	None	None	None	None	None	Back
Power-on switch	Front	Front	Keyboard	Side	Back	Side	Side
Reset button	None	None	Keyboard	None	None	Side	None
BATTERY							
Battery type	Removable	Removable	Removable	Removable	Internal	Removable	Removable
Battery material	Nickel cadmium	Nickel cadmium	AA batteries	Lead acid	Nickel cadmium	Nickel cadmium	Nickel cadmium
Claimed battery life	3.5 hours	2 hours	100 hours	5 hours	2.5 hours	2 hours	3 hours
Battery charge time	8-10 hours	8-16 hours	N/A	10 hours	8 hours	4 hours	2-3 hours
Battery voltage and Amp/hours	4.8V, 5Ah	12.6V, 0.8Ah	3V, 0.3Ah	6V, 1.8Ah	9V, 1.1Ah	7.2V, 1.7Ah	9V, 1.2Ah
Battery conservation techniques	Display, disk, port, and processor shutdown	Display shutdown	Display, disk, port, and processor shutdown	Display shutdown, floppy disk drive standby mode	None	Display and processor shutdown, modem/speaker toggle	Display shutdown, manual I/O shutdown
Transformer weight (lbs.)	1.4	1.2	N/A	0.52	1.3	0.65	0.97
Transformer size (inches)	3.1 x 5.1 x 2.1	1.5 x 2.75 x 5.75	N/A	2.25 x 3.75 x 1.5	2 x 3 x 1.75	2.63 x 4.5 x 1.5	3.0 x 7.3 x 1.3
Car battery adapter available	■	□	□	□	■	■	□
OPTIONS							
External floppy disk drives	■	■	■	□	■	■	■
Capacity	1.44MB, 360K	1.44MB	1.44MB	N/A	360K	360K	720K, 360K
Size	3.5-, 5.25-inch	3.5-inch	3.5-inch	N/A	5.25-inch	5.25-inch	3.5-, 5.25-inch
Modems (bits per second)	2,400	2,400	None	2,400	1,200, 2,400	2,400	1,200
Carrying case	■	■	■	■	■	■	■
MISCELLANEOUS							
Distribution (dealer or direct)	Dealer	Dealer	Dealer	Dealer	Dealer	Dealer	Dealer
Warranty	1 year	1 year	1 year	90 days	1 year	1 year	1 year
Service	Return to dealer	Ship to manufacturer	Ship to manufacturer	Return to dealer	Ship to manufacturer or return to dealer	Ship to manufacturer or return to dealer	Return to dealer
FCC certification	B	B	B	B	B	B	B

□—Editor's Choice ■—Yes □—No

N/A—Not applicable: the product does not have this feature.

ENDS

Also available are plug-in memory cards the size of your company credit card, containing such popular programs as *WordPerfect* and *Lotus 1-2-3*. Thanks to a dedicated nickel cadmium battery for memory, data and programs stored in the UltraLite's RAMdisk are safe for five to seven days between charges.

NEC's 80C86-equivalent V30 microprocessor runs at either 9.83 or 4.92 MHz to provide the computing power you need at a weight you can carry. 10-MHz speed may not blow away the competition, but try to fit one of the faster notebooks into your briefcase with other items.

The most surprising and satisfying aspects of the UltraLite are its screen readability and keyboard comfort. The machine's 4.25- by 8.25-inch CGA backlit display is bright and highly adjustable. Text characters are large, crisp, and easy on the eyes. Don't expect miracles, though: the UltraLite's screen is not intended for high-speed graphics, as witnessed by our video benchmark tests.

This machine isn't geared for presentation work—it's aimed instead at the heart

PC
FACT FILE

EDITOR'S CHOICE



NEC UltraLite
NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; (800) 366-3632, (800) 826-2255 (dealer location).
List Price: With 640K RAM, 1MB silicon static RAMdisk, CGA liquid crystal display, DIN-style serial port, 2,400-bps internal modem, DOS 3.3, Laplink, MS-DOS Manager, \$2,499; with 2MB silicon RAMdisk, external 1.44MB 3.5-inch floppy disk drive, \$3,398. Spare internal battery, \$119; external high-capacity battery, \$199; external 1.44MB 3.5-inch floppy disk drive, \$399; parallel port adapter, \$199; utility carrying case, \$89; leather carrying case, \$129.
In Short: NEC's 2MB silicon RAMdisk, no-compromise screen, real keyboard, and sub-4.5-pound weight make this the machine of choice for the executive on the fly. But an external battery charger would make this winner a perfect ten.

CIRCLE 828 ON READER SERVICE CARD



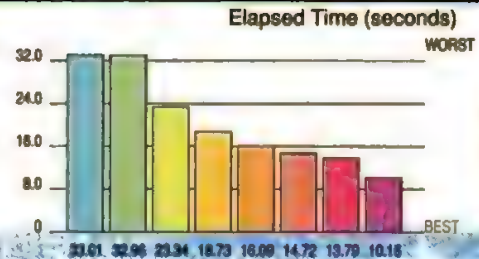
BENCHMARK TESTS: 8086/8088-BASED PORTABLES

The NEC UltraLite emerges as the fastest notebook computer in terms of high system speed, but the Compaq LTE and the Toshiba T1000SE achieve better performance when you consider overall system, disk, and video efficiency.

PROCESSOR AND MEMORY BENCHMARK TESTS

8086 Instruction Mix

The 8086 Instruction Mix benchmark test times a series of tasks specific to the 80286 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.



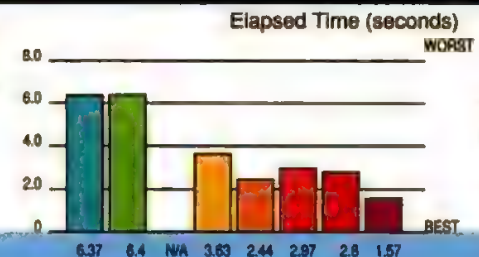
Floating Point Calculation Without Coprocessor

The Floating-Point Calculation Without Coprocessor benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.



Conventional Memory

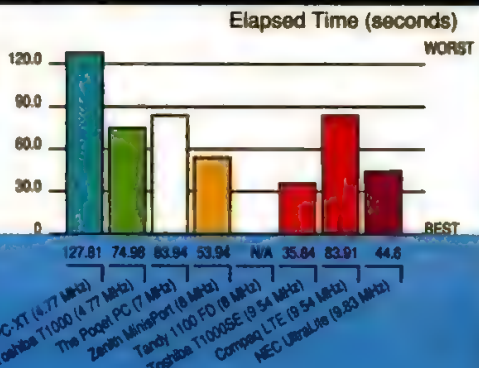
The Conventional Memory benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.



DISK BENCHMARK TESTS

DOS File Access (Small Records)

The DOS File Access (Small Records) benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.



N/A—Not applicable: this computer could not perform the test.

* Reported for comparison.

CONTINUES



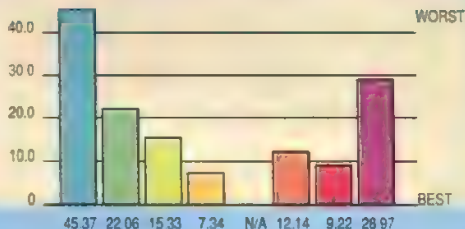
BENCHMARK TESTS: 8086/8088-BASED PORTABLES

DISK BENCHMARK TESTS

DOS File Access (Large Records)

Elapsed Time (seconds)

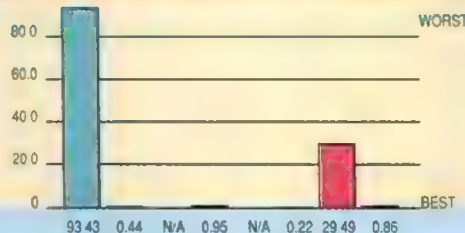
The **DOS File Access (Large Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.



BIOS Disk Seek

Elapsed Time (milliseconds)

The **BIOS Disk Seek** benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.



N/A—Not applicable: this computer could not perform the test.

* Reported for comparison

Relative Times
(4.77-MHz IBM PC-XT = 100)

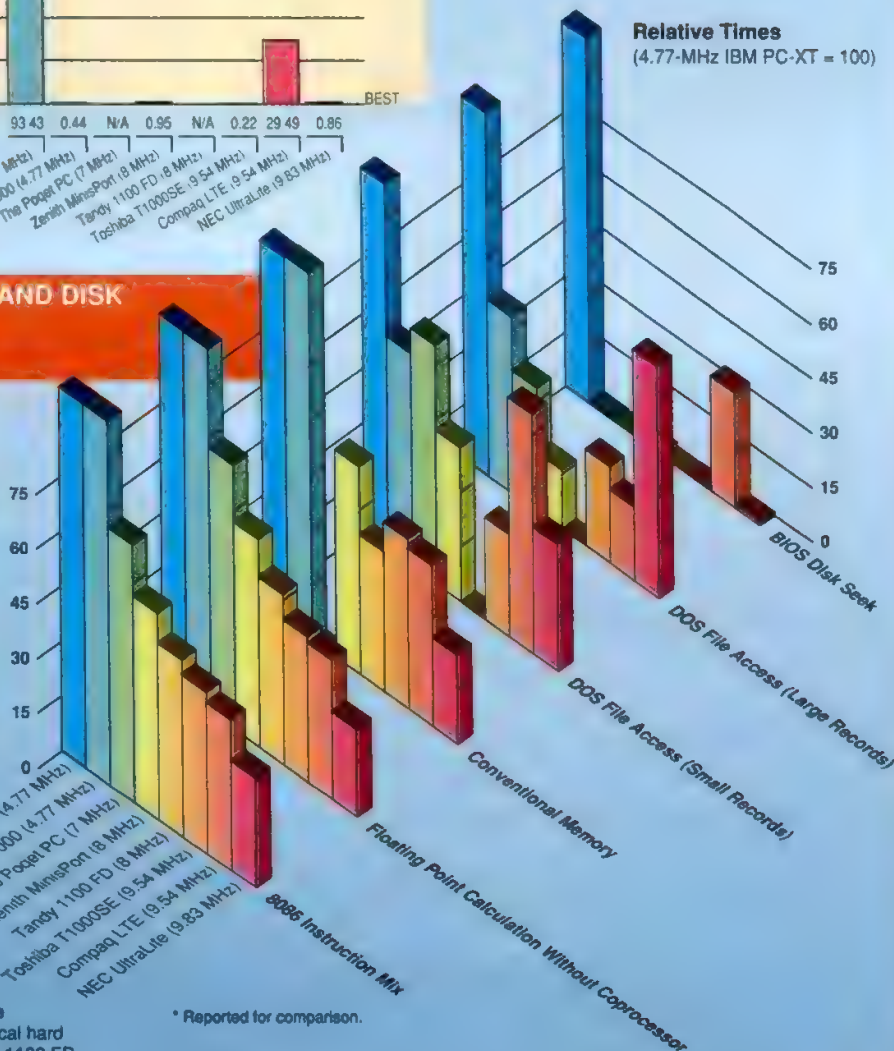


PROCESSOR, MEMORY, AND DISK BENCHMARK TESTS: COMPOSITE VIEW

All seven notebook computers reviewed in this section outperform the original 4.77-MHz IBM PC-XT. The benchmark test results should be considered in the context of the type of work that will be performed on these systems.

The Tandy 1100 FD and the NEC UltraLite use NEC functional equivalents to the Intel 8088 and 8086 chips; the V20 and V30, respectively. The NEC UltraLite is the fastest machine overall on processor and memory tests because it operates at 9.83 MHz, faster than any of the other notebook models. The Compaq LTE and the Toshiba T1000SE, at 9.54 MHz, are the next-fastest, while the 4.77-MHz Toshiba T1000 uses the slowest chips of all.

Because these machines are designed for portability, most of them do not have a hard disk. The one exception is the Compaq LTE, tested here with a 20MB 29-millisecond ST-506 hard disk from Conner Peripherals; this compares favorably with the hard disks in other, larger 8086-based portables. PC Labs tested the silicon RAMdisks in the NEC UltraLite, the Toshiba T1000SE, and the Zenith MinisPort, as well as the 768K add-on RAM card in the Toshiba T1000. Because using a RAMdisk does not involve mechanical operation, BIOS Disk Seek times are significantly faster than with a standard mechanical hard disk. No disk test scores are given for the Tandy 1100 FD because it has no hard disk, and its silicon disk is read-only.



* Reported for comparison.

CONTINUES

BENCHMARK TESTS: 8086/8088-BASED PORTABLES

VIDEO BENCHMARK TESTS

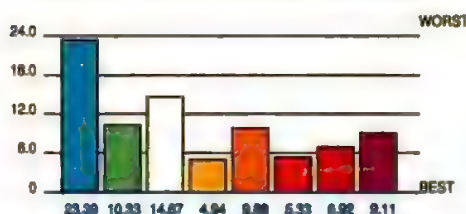
Direct to Screen

The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.



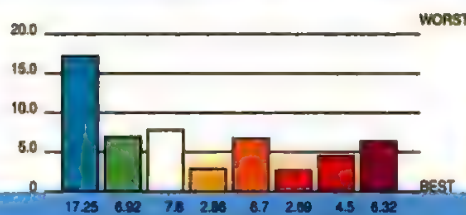
Video BIOS Routine with Scrolling

The **Video BIOS Routine with Scrolling** benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.



Video BIOS Routine Without Scrolling

The **Video BIOS Routine Without Scrolling** benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.



* Reported for comparison.

of the business traveler. Even the keyboard attests to this. The keys are laid out AT enhanced style, with 12 half-size function keys across the top. The feel of the keyboard is similar to that of Compaq's SLT and LTE machines, lacking the clicky feel of standard keyboards but easy to use.

The keyboard's only drawback is its cursor pad; all four arrow keys are arrayed in a comfortable, logical layout just where you'd expect them in the lower-right-hand corner, but you need to press the Fn key to activate PgUp, Home, PgDn, and End. And the Del and Ins keys are in the upper-right-hand corner, an awkward reach.

The UltraLite does present some obstacles to computing on the road. Battery life on PC Labs' Battery Rundown tests topped out at just under 2 hours for the UltraLite's lithium system battery. NEC will begin to market optional additional battery packs early this year, but at \$119 a throw and with no external battery charger (or quick charge provision), they're expensive as well as awkward to swap and recharge. You can unscrew the battery pack from the back of the case, but the battery can be recharged only while it's in the machine, via the UltraLite's AC power adapter—an 8- to 16-hour process. Short of buying a second UltraLite to juice up spare batteries, taking extra power with you means charging your spares days in advance.

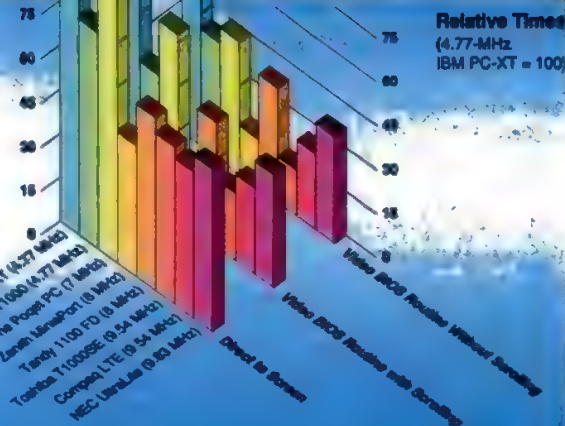
This is not a machine for those who need floppy disk access or hard copy on the fly. The UltraLite's parallel printer port resides on its \$399 1.44MB 3.5-inch external floppy disk drive (which operates only with AC power) or with a \$199 parallel adapter. The serial port is a DIN-style connector with an RS-232 adapter cable.

Is this the portable for you? Not if you're making data-intensive trips that require disk-to-disk data transfer and printed output on the spot, and especially not if those jaunts feature long stretches between AC outlets and desktop computers. But if you're looking for lightweight technology that will let you write your memos, check your e-mail, and calculate your spreadsheets without trading your briefcase for a duffel bag, you've found your portable solution.



VIDEO BENCHMARK TESTS: COMPOSITE VIEW

For TTL telecommunications and character-based word processing and spreadsheets, all the CGA-resolution notebook computers in this section scored comparably well on the video performance tests except The Poqet PC. This unit's slower performance was due to unique battery-conservation techniques involving its nonvolatile, reflective liquid crystal display.



* Reported for comparison.

ENDS

POQET COMPUTER CORP.

The Poqet PC

by Jonathan Matzkin

The \$1,995 Poqet PC shatters all conventional notions of what a PC compatible looks like. With its minuscule 1- by 8.75- by 4.25-inch (HWD) dimensions and feathery 1-pound weight, the Poqet makes even the diminutive NEC UltraLite look huge by comparison. This incredible compactness is by no means the only revolutionary thing about the Poqet, but it certainly is its most immediately noticeable attribute. Casually put the Poqet on a table in a room full of jaded power users, and you will hear a chorus of near disbelief, followed by a scramble to be the first to pick it up and try it.

Just as the first desktop machines defined new roles for computers, the Poqet will take computers where they have never gone before. A tight fit in your jacket pocket, the Poqet disappears in the cramped confines of a typical briefcase or portfolio. Put another way, the Poqet fits in your luggage; conventional laptops *are* luggage.

While laptop users struggle with rechargeable batteries and limited comput-

ing time, the Poqet runs on ordinary AA batteries. Poqet claims 100 hours of computing time from two cells. When they run down, you simply walk into the nearest store and buy new ones. Try that with most laptops.

To squeeze a useful length of computing time out of such a modest power source, Poqet Computer devised an innovative power-management scheme. The 80C88 processor is powered down whenever possible, even between keystrokes, to minimize battery drain.

Its cursor place-mark feature and compact dimensions make the Poqet perhaps the most convenient electronic note taker devised.

That aggressive power management leaves enough juice to keep The Poqet PC's 512K of static RAM alive when you turn off the machine by tapping the keyboard-mounted I/O switch. Another tap of the switch returns you to wherever you left off; you can power down in the middle of a word processor document and return to exactly the same cursor position with just a touch. This place-mark feature combines with the Poqet's go-anywhere dimensions to make this perhaps the most convenient electronic note taker ever devised.

At first glance, the Poqet's nonexpandable 512K RAM complement seems limited in this age of multiple megabytes, but the Poqet features extensive ROM-executable software. The 640K of ROM includes a suite of applications and utilities that all execute in ROM, leaving RAM free for other uses, such as RAMdisks. These ROM-based Poqetools include a calculator, a simple word processor, a scheduler, an address book, and a terminal emulator.

You can run standard DOS applications in RAM, but several software developers are readying ROM-executable Poqet versions of their applications, and others will produce conventional RAM-executable

versions. All of these applications, including *AlphaWorks*, and *Lotus 1-2-3* in ROM and *WordPerfect 5.0*, *Xywrite III Plus*, and *ACT!* in RAM-executable form will be distributed on the solid-state memory cards that the Poqet uses instead of disks. The cards are also available for data storage in densities ranging from 64K (\$160) to 512K (\$595).

Poqet also plans an external 3.5-inch floppy disk drive for the system. We saw a preproduction version of the drive, which successfully read and wrote 1.44MB disks, but was not yet compatible with 720K disks. The production unit Poqet sent *PC Magazine* for this review has also corrected most of the fit and finish problems of the system previewed in *First Looks* (*PC Magazine*, November 14, 1989). In particular, the keyboard is vastly improved, but it is still the Poqet's most obvious shortcoming.

The keyboard now is much steadier with a more solid feel. The problem of keystrokes failing to register has now been ironed out. That said, the Poqet's keyboard is still not really adequate for serious extended writing use. The keys must be hit firmly, and directly from above. This, and the small size of the keyboard make it difficult to touch type.

The Poqet's CGA-compatible screen, which displayed surprisingly good contrast on the prototype model, has been made even better for the production model. The screen font is necessarily small, but the Poqet's display is more than adequate.

On PC Labs benchmark tests, the Poqet solidly outperformed both the original 4.77-MHz IBM PC and Toshiba's workhorse T1000. It did not perform quite up to the standards set by more-advanced notebook style laptops, however. Performance aside, the Poqet is the only choice in situations that demand a pocket-size machine that will run DOS software. The Poqet meets that challenge with a truly impressive display of cutting-edge technology.

TANDY CORP.

Tandy 1100 FD

by Bruce Brown

Tandy gets credit for starting this whole laptop business in the first place, with its Model 100. The Model 100 didn't run DOS software but was so conveniently light and easy to use that many people figured out how to trade files between it and



The Poqet PC

Poqet Computer Corp., 650 N. Mary Ave., Sunnyvale, CA 94086; (800) 624-8999, ext. 1591, (408) 737-8100.

List Price: With 512K RAM, 32K memory card, CGA nonbacklit liquid crystal display, parallel port, serial port, utilities, DOS 3.3, GW-BASIC, two AA batteries, \$1,995. Optional 64K card, \$160; 256K card, \$375; 512K card, \$595.

In Short: The Poqet PC is a technological breakthrough simply because of its lilliputian dimensions. Beyond that, it offers substantial innovations in power and memory management. Only the keyboard lags behind.

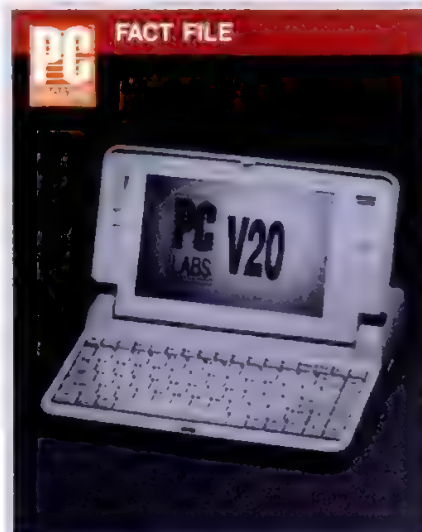
CIRCLE 629 ON READER SERVICE CARD

PORTABLES 8086/8088-BASED

IBM compatibles; the Model 100 more than once was referred to in the press as one of the most popular IBM PC accessories. Tandy's new entry in the low-weight DOS world of notebook computers, the 8-bit, V20-based Tandy 1100 FD, carries on the Model 100's examples of good price, light weight, and easy functionality.

The 1100 FD lists for \$999 with 640K of RAM, a 720K 3.5-inch floppy disk drive, a serial port, a parallel port, a CGA liquid crystal display, a battery and AC adapter, DOS 3.3, and the *DeskMate* software.

While the 1100 FD alone is a fine value, the bundled software and the manner in which Tandy provides this software double and redouble the machine's value. DOS is permanently stored in ROM along with the core *DeskMate* interface and the word processing and spelling checker modules. Other *DeskMate* applications are on diskette, including a calendar, spreadsheet, filer, form design, address book, calculator, notepad, phone list, drawing program, telecommunications program, and *PC-Link* software, a program used to hook up via optional modem with the *PC-Link* Online Information Service. None of the *DeskMate* applications compete with full-featured applications; for example, the spreadsheet is limited to 99 columns and 99 rows, but each offers fine value with basic functions of its genre.



Tandy 1100 FD

Tandy Corp., 1800 One Tandy Center, Fort Worth, TX 76102; (817) 390-3011.
List Price: With 640K RAM, one 720K 3.5-inch floppy disk drive, CGA nonbacklit liquid crystal display, parallel port, serial port, DOS 3.3, *DeskMate*, *PC-Link*, \$999. Internal 2,400-bps modem, \$199.95; spare battery, \$29.95.
In Short: Tandy's very creditable MS-DOS notebook computer entry has a slightly odd though readable screen, memory expansion is limited to the standard 640K. The 1100 FD is small, well made, and with DOS and a word processor and spelling checker built-in, an excellent buy for students or anyone looking for a lightweight DOS-compatible unit.

CIRCLE 639 ON READER SERVICE CARD

The 1100 FD certainly fits the notebook class. It weighs 6.3 pounds with a battery and measures 2.5 by 12 by 9.75 inches (HWD). The half-pound AC adapter is about the size of a pack of cigarettes, and extra batteries weigh three quarters of a pound. If you use the floppy disk drive standby mode, the battery lasts up to 5 hours. On PC Labs' Battery Rundown tests, with all conservation techniques disabled, it held out for 2 hours and 17 minutes. The batteries take about 10 hours to charge with extras costing a mere \$29.95. The notebook has no handle, but it's so light it will probably be carried inside something else, like a typical briefcase or book bag.

The 1100 FD's display shows blue characters on a green background, a combination more pleasing than it probably sounds. The screen technology is called supertwist nematic, and it depends on outside lighting; don't count on using this one on a darkened airplane. The screen is CGA with a flat aspect ratio (so circles appear as ovals). It's not a great graphics machine, but it's certainly good enough for the *DeskMate* graphical user interface.

The keyboard has 84 keys, including separate cursor control, page movement, and unshifted asterisk keys. The key travel is short and the top-row function keys are smaller than the rest on the keyboard. You might not want to type forever on this key-



PERFORMANCE TESTS: 8086/8088-BASED PORTABLES

The Compaq LTE came in with the best all-around combination of performance and battery life, primarily because of its 4.8-volt, 5-Amp/hour nickel cadmium battery. The Toshiba T1000 was close behind on the battery test, but unlike the Compaq LTE, its liquid crystal display is not backlit (the same objection applies to the Tandy 1100 FD). The Compaq also has a 20MB hard disk to spin, making its performance that much more impressive.

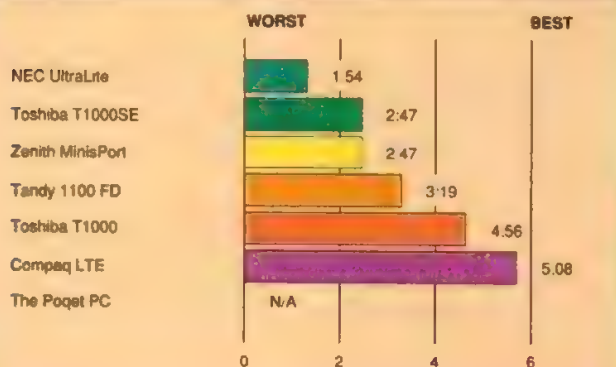
The Toshiba T1000SE and Zenith MinisPort edge out the NEC UltraLite, thanks to larger-capacity batteries (1.7 and 1.2 versus 0.8 Amp/hour). NEC has improved its nickel cadmium battery design: the battery is now removable and has gained 33 minutes of life since we tested the same computer for the October 17, 1989, issue of *PC Magazine*.

The Poqet PC features technology that purportedly allows the unit to run up to 100 hours on two standard AA batteries. Unfortunately we were not able to adapt the machine for our tests and verify the manufacturer's claims in time for this issue.

The **Battery Rundown** performance test involves teletyping five screens of text to the laptop computer's display, then writing a 15K file to the hard disk once every minute until the battery runs out of power. All power conservation techniques are disabled.

BATTERY RUNDOWN

Elapsed Time (hours and minutes)



N/A—Not applicable: this machine was not compatible with PC Labs' Battery Rundown test.

board, but it's not bad, reminiscent in feel to the original Compaq keyboard.

Tandy computers are sold and serviced at over 7,000 Tandy Computer Centers and Radio Shack stores. Don't expect discounts. The available options include two carrying cases at \$39.95 and \$49.95 and a \$199 2,400-bps internal modem. The standard parts-and-labor warranty is good for 90 days but extended service plans are available.

While the Tandy 1100 FD alone is a fine value, the software doubles and redoubles the machine's value.

Keep in mind that the 1100 FD is intended for a broad spectrum of low-end users. By placing essential start-up software in ROM, the system's limitations of non-expandable 640K RAM and a 720K floppy drive with no optional second drive or hard disk are overcome somewhat. Obviously, this machine isn't appropriate for power users who need huge files, fast as possible performance, or top-of-the-line graphics. The 1100 FD's biggest competitors are the Toshiba 1000 (street price, around \$600) and the Toshiba 1000SE (street price, probably around \$1100, when available). This machine holds its own and may be the best deal, if you want an integrated package featuring both hardware and software.

TOSHIBA AMERICA INFORMATION SYSTEMS INC.

Toshiba T1000

by Lori Grunin

In the three years since Toshiba's T1000 hit the market, the 6.25-pound laptop has aged gracefully. It can't compete feature for feature with the young upstarts like its sibling the T1000SE or the NEC UltraLite, but at \$999, it certainly holds a substantial price advantage over the other entrants in



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At a carrying weight—machine plus AC adapter—of 7.5 pounds, the T1000 won't overburden you. The keys on the keyboard are well laid out and well spaced, but lack springiness. By far the weakest component of the T1000 is its display. Reading the small reflective supertwist LCD screen for an extended time is uncomfortable, but not impossible. Since the battery can't be removed, you don't have the option of swapping batteries to extend

The Toshiba T1000 is a computer for people to whom the phrase "under \$1,000" means the difference between buying and not buying.

run time; however, the 5-hour battery lasts about twice as long as many removable-battery machines.

Of course, there's something to be said for a machine that's been around the block a few times; you're not the one who discovers the bugs. By today's standards the technology seems outdated—especially the nonremovable battery and small, non-backlit display—but at \$999 (with street prices of less than \$600), the T1000 is a perfectly serviceable computer for people to whom the phrase "under \$1,000" means the difference between buying and not buying.

TOSHIBA AMERICA INFORMATION SYSTEMS INC.

Toshiba T1000SE

by Lori Grunin

When you power up the \$1,699 T1000SE, you can't help but admire the outstanding backlit liquid crystal, double-scan CGA display. The screen is slightly longer than those of the other notebook machines—4.75 inches tall by 7.5 inches wide; when coupled with Toshiba's distinctive text font, you get a remarkably

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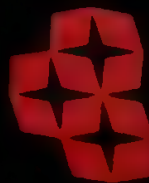
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Photographs: Harry Langdon

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diet cola. Obviously Northgate has

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f you're thinking of slimming down,
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You said it.

Since at least three of the medals garnered by General Northgate were for our highly acclaimed Elegance series (triple Editors' Choice awards from PC Magazine, for example), we thought we'd show you what the machine looks like and give you a few specs in case you might be inclined to buy this elegantly designed state-of-the-art computer. First of all, to photograph an elegant machine . . . you need an elegant photographer. So we went to the most highly respected lensman in Hollywood: Harry Langdon. He normally lights and shoots such famous faces as Linda Evans, Victoria Principal, Cher, Arnold Schwarzenegger and Diana Ross, to name just a few. So shooting a different pretty face like a Northgate Computer is all in a day's work for Harry. For one thing, Northgate doesn't need a hairdresser.

The Elegance series to your left comes in three versions: The 20 and 25 MHz models, and our top of the line/highest performance Elegance: the 33 MHz which earned a 9.1 rating in Infoworld.

The price of the complete 386™ 33 MHz Elegance system pictured: \$5995.00. (Of course, you can buy a fully configured Elegance system starting at \$3395.00.)

The only thing more impressive than the price is the tech support which comes along with our usual 1 year parts and labor warranty. Did we mention that we also ship you replacement parts, should they be needed, overnight at our expense? And that our tech support people are actually here for you 24 hours a day, every day, every night?

Put us to the test: give us a call some night at midnight. Or 3:00 AM. Now to the specs:

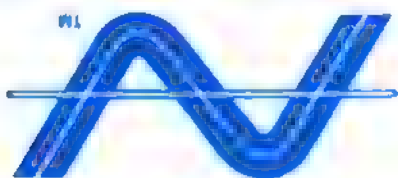
Technobabble.

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And for the newest member of the Northgate 386 family, open up this fold-out.



E l e g a n c e



PHOTO: JERRY LANGDON

THE NORTHGATE 386 33-MHz ELEGANCE SYSTEM

- *"1a. Refinement and grace in movement, appearance or manners.
b. Tasteful opulence in form, decoration or presentation.
2. Something that is elegant." (American Heritage Dictionary)

lost a few pounds.

At least in the 386/20 picture
How do we pack a 20 MHz
into this space saving, smaller

We do it.

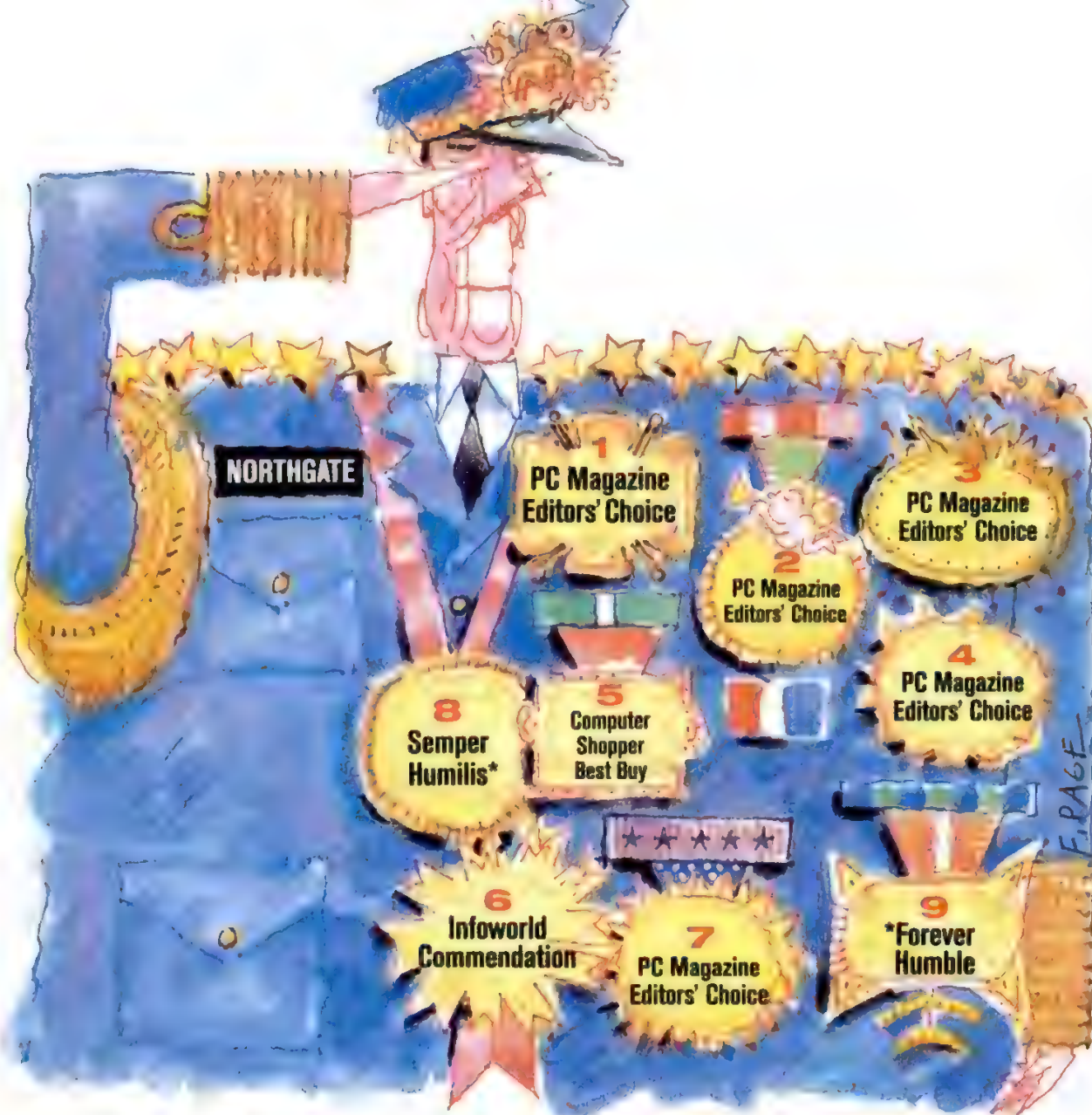
It comes with a VGA monitor
Slim price too: \$2,499.00 for
competition match this.

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Northgate Computer System

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as tall as America's favorite



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And Samuel F.B. Morse, father of an earlier form of communications, before the world became computerized. (If you think we're making this up, check out Morse's be-medaled photo on the back page of this special Northgate insert.) In the meantime, we could go on and on with the reasons to buy a Northgate system, but we thought the awards said it better than we could.

1. PC Magazine "Editors' Choice" award: 80286 SuperMicro. (PC Magazine, January, 1989)
2. PC Magazine "Editors' Choice" award: 80386 Elegance 20 MHz. (PC Magazine, May, 1989)
3. PC Magazine "Editors' Choice" award: 80386 Elegance 25 MHz. (PC Magazine, May, 1989)
4. PC Magazine "Editors' Choice" award: 80386 Elegance 33 MHz. (PC Magazine, October, 1989)
5. Computer Shopper "Best Buy" awards, three years in a row, based on a vote of the magazine's readers. • Best Buy — complete computer system • Best Buy — overall (all products advertised in the magazine) • Best Buy — input device: Northgate Omnikey Keyboard.
6. Infoworld. In April of 1989, they saluted Northgate's Elegance 386/25 with the headline: "The Elegance 3000 among the fastest 25-MHz systems" (Infoworld, April 10, 1989). In November, in their review of our Elegance 386/33, they said the following: "Northgate's Elegance 386-33/2000 computer is a top product in most of our scoring categories including value, where it earns just the second excellent mark we've awarded to 33 MHz systems." Overall rating 9.1, their highest ever.
7. PC Magazine "Editors' Choice" award: Northgate's Omnikey Keyboard. 8. "The Northgate Humility award" given to the most modest computer company in Plymouth Minnesota. So there you have it. And the year is still young. Northgate: "Semper Humilis." (Forever Humble).



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6



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PORTABLES

8086/8088-BASED

readable, comfortable display. Complete with Toshiba's CHAD utility—which lets you choose your character attributes—the T1000SE features one of the best displays possible in a notebook machine.

The removable battery, which lasts about 2 hours, will give out long before your eyes. The clever latch design is similar to that of the T1600, but the 11-ounce unit slides off the back of the machine rather than the front. In addition to plugging the 10.4-ounce transformer into the machine, you can charge the battery plus any extras (\$79 each) with the 3-battery external charger (\$349).

To maximize battery life, you can disable the 2,400-bps modem (\$349), speaker, or battery alarm on the fly, as well as set the display to shut down after a specified interval of disuse. The same pop-up window holds a gauge measuring how much juice you've got left. (A blinking LED indicator heralds your last few minutes of power.) You can also toggle the processor speed between a less power-hungry 4.77 MHz and the default 9.54 MHz.

The T1000SE is slightly larger than the NEC UltraLite, tipping the scales at 6.2 pounds with the 2,400-bps modem in-

stalled in a 1.75- by 11.7- by 10-inch case (HWD), but this notebook comes standard with a 1.44MB 3.5-inch floppy disk drive.

Instead of a hard disk drive, the T1000SE uses a battery-backed RAMdisk

With Toshiba's CHAD utility, the T1000SE features one of the best displays possible in a notebook machine.

(called HardRAM) to supplement the floppy disk drive. The unit comes with 1MB of RAM, of which 384K can be configured as a RAMdisk or as expanded memory. You can also buy a 1MB (\$699) or 2MB (\$1,199) RAM card that slides easily into a slot on the side of the machine for a maxi-

mum of 3MB total memory. As long as the backup battery has power (estimated at 12 hours after the main battery discharges, according to Toshiba), the data in your HardRAM is safe.

Also notable is the keyboard, which is well laid out with a firm, springy action, and earns as many accolades as the display. In addition, Toshiba integrated the AutoResume feature found in some of its other portables into the T1000SE; when you turn off the power, the system "remembers" its state, and upon power-up restores your environment.

A serial port, combination parallel port/external floppy disk drive connector, and 100-pin expansion bus connector (for use with third-party expansion boxes) are the only external I/O ports available. The T1000SE lacks the ability to drive an external monitor.

Our review unit posed no problems, with the exception of a slightly sticky Ctrl key. Although the plastic latch that holds the T1000SE closed allows you to open the top with one hand and keeps the computer's weight down, it feels flimsy. The T1000SE also has no handle, which makes the \$99 carrying case a necessity unless

MOVING?

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EDITOR'S CHOICE

- Toshiba T1000SE
- NEC Ultralite

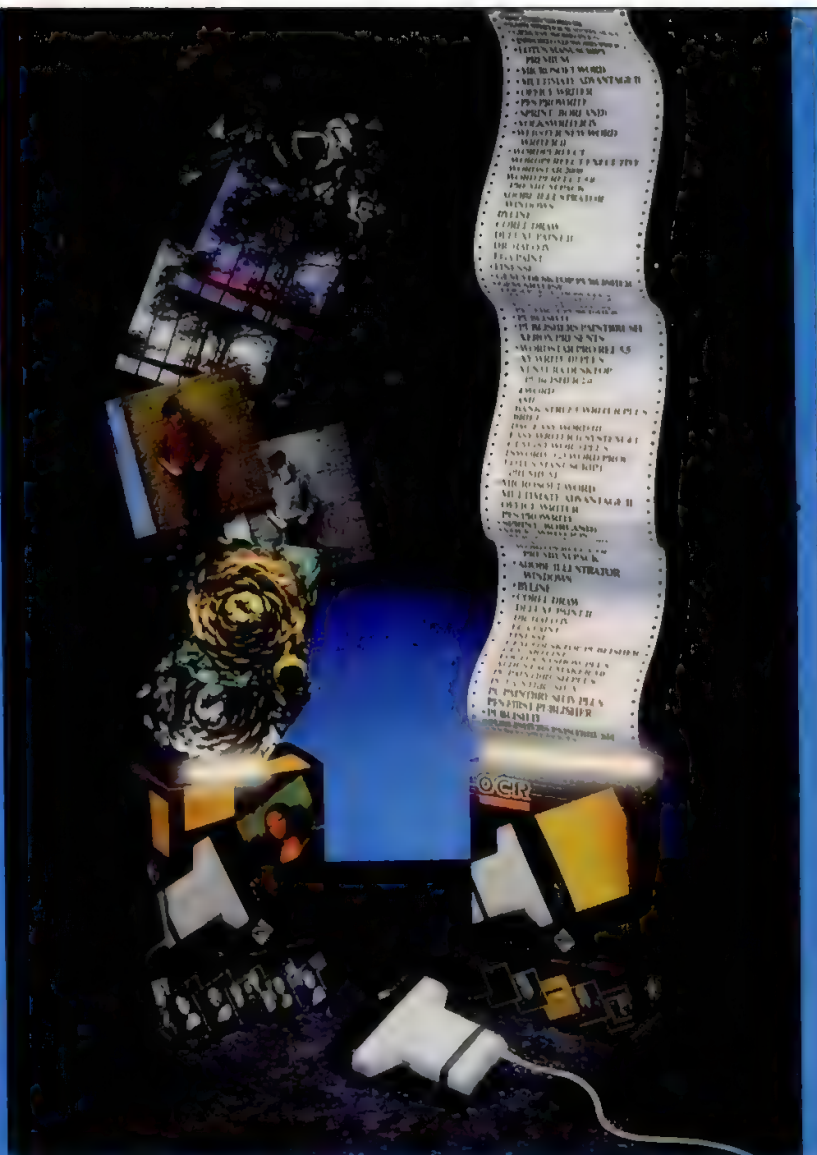
Our reviews of 8088- and 8086-based portables covered only the machines that matter: battery-powered DOS-based notebook units weighing 7 pounds or less. Among the seven we reviewed, the Toshiba T1000SE stands out for all-around excellence, and the NEC UltraLite shines in a niche category. Those two are our Editors' Choices.

8088- and 8086-based portables have only half to a third of the computing power of a 286, and these seven feature CGA displays. If you want a big EGA or VGA screen and a hard disk, look instead at a 286 portable. But if you have lighter computing needs including the ability to send data back to the home office, an 8088/8086 laptop with a modem and a good integrated software package is all you need.

Head of the class for overall computing in a notebook machine is the 6-pound, 1.75 by 12 by 10 inch Toshiba T1000SE. The T1000SE has a comfortable keyboard and bright 8 by 5 inch CGA LCD, the largest in this class. Its quick-change battery provides 2-plus hours of power, and with Toshiba's AutoResume feature, you can turn off this laptop in the middle of any application and return to it at a later time. The T1000SE comes with 1MB of RAM plus the option of adding a 1MB or 2MB silicon RAM card (highly recommended) as well as a 1.44MB floppy disk drive—far superior to the 768K RAMdisk and 720K 3.5-inch floppy disk drive of the original T1000, which remains on the market.

The 4.5-pound NEC UltraLite is the only product of its kind. In the year since its release, NEC has improved the screen brightness, cut down on screen reflections, made the battery pack easier—if not easy—to change, and dropped the price by \$700 so that you can buy the 2MB silicon disk version on the street for under \$2,000. That's the version

CONTINUES



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 - 387SX math coprocessor socket
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 - 101-key enhanced keyboard
- Monitor optional.

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PC Magazine, February, 1989

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- LIM 4.0 support
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- Built-in parallel port and two serial ports
- Five available expansion slots
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PC Magazine, May 30, 1989

- 386 processor running at 20MHz
- High-speed cache memory controller with 32KB of static RAM cache
- 1MB fully available RAM expandable to 16MB
- Disk caching software
- LIM 4.0 support
- ROM shadowing into faster DRAM
- Dual diskette controller with dual hard drive interface

- Built-in parallel port and two serial ports
- Five available expansion slots
- 387 math coprocessor socket
- Choice of 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- 40MB hard disk drive
- Monochrome VGA monitor
- 16-bit VGA video adapter card
- 101-key enhanced keyboard
- New Spinnaker Eight-in-One integrated software
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PC Magazine, May 30, 1989

- 386 processor running at 25MHz
- High-speed cache memory controller with 32KB of static RAM cache
- 1MB full available RAM expandable to 16MB
- Disk caching software
- LIM 4.0 support
- ROM shadowing into faster DRAM
- Dual diskette controller with dual hard drive interface
- Built-in parallel port and two serial ports
- Five available expansion slots
- 387 math coprocessor socket
- Choice of 5.25" 1.2MB or 3.5" 1.44MB diskette drive
- 40MB hard drive
- Monochrome VGA monitor
- 16-bit VGA video adapter card
- 101-key enhanced keyboard
- New Spinnaker Eight-in-One integrated software
- Free one-year onsite service

Color monitor optional.

CompuAdd 316 Monitor And Hard Drive Options

	MVGA	CVGA
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80MB (19ms)	64813 -	64818 -
110MB (19ms)	64814 -	64819 -
150MB (18ms)	64815 -	64820 -

CompuAdd 320 Monitor And Hard Drive Options

	MVGA	CVGA
40MB (28ms)	64823 -	64829 -
80MB (19ms)	64824 -	64830 -
110MB (19ms)	64825 -	64831 -
320MB (18ms)	64826 -	64832 -

CompuAdd 325 Monitor And Hard Drive Options

	MVGA	CVGA
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Color monitor optional.

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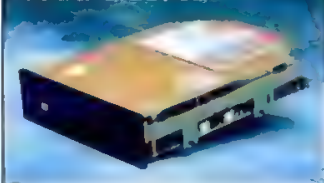
Professional Starter Kit Monitor And Hard Drive Options

	MGA	EGA	CVGA
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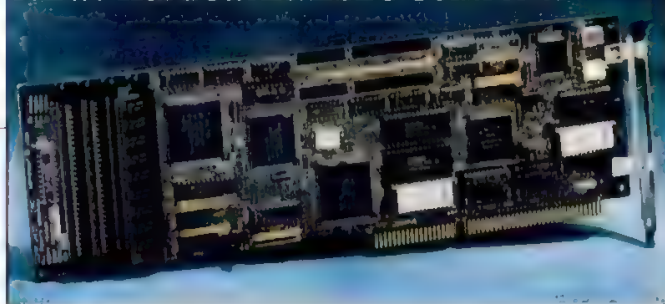
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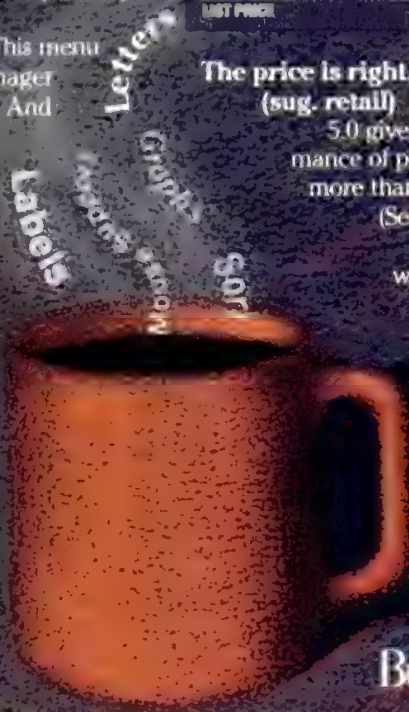
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CIRCLE 194 ON READER SERVICE CARD

PORTABLES

8086/8088-BASED



EDITOR'S CHOICE

CONTINUED

worth considering. We're still annoyed by the nonstandard adapter on the serial port that you have to remember to carry everywhere you go, the noncloning version of *Lap-Link* in ROM, the late delivery of ROM card software that is typically one revision older than the floppy disk versions, and the failure of NEC to deliver an external battery charger.

The UltraLite still requires special care—for instance, it must be recharged every week or you'll lose the contents of the silicon disk—and the *Lap-Link* data transfer is a bit more complicated than just saving files to a floppy disk. That keeps the UltraLite from being *the* tool for every executive—it still requires more time to master than many executives might care to spend. But for anyone who needs a full-size keyboard and a bright backlit CGA display in a standard DOS machine that measures only 1.25 by 12 by 8.25 inches (a half-inch thinner and 1.5 pounds lighter than the T1000SE), the UltraLite can't be beat.

And what of the machines that aren't Editor's Choices?

If you *have* to have a notebook portable with both floppy and hard disk drives, the 7-pound Compaq LTE would be your choice. But why stop there? With the Compaq LTE/286 (our Editor's Choice for 286 laptops) you can get real work done.

Zenith's MinisPort just doesn't cut it. The 2-inch, 720K floppy disk is about as much of a standard now as 8-track tapes, and the screen is too small and too dim.

No matter how cheap you can find the Toshiba T1000 (perhaps \$500), we think you're better off with the SE version. The T1000 suffers with the only display smaller than the MinisPort, but remember that the T1000 was introduced almost three years ago. If you want a simple, cheap, nonexpandable machine with a nonilluminated screen, consider

CONTINUES

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CIRCLE 289 ON READER SERVICE CARD



EDITOR'S CHOICE

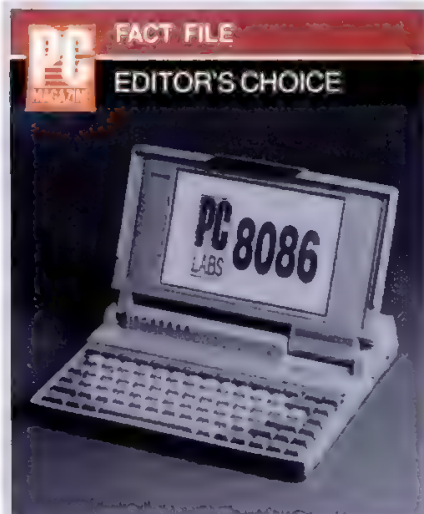
CONTINUED

Tandy's 1100 FD for \$999 list, including DOS and Tandy's DeskMate software permanently stored in ROM.

We were impressed enough by the 1-pound, palm-size Poqet PC to give it an Award for Technical Excellence last fall. While it is backed with impressive technology the current version still needs to iron out some of the practical kinks before we can wholeheartedly recommend the Poqet.

you have a briefcase.

If the three items at the top of your list of required features for a notebook machine are a good display, a good keyboard, and the ability to accept standard storage media, then you need look no further than the T1000SE.



Toshiba T1000SE

Toshiba American Information Systems Inc., Computer Systems Division, 9740 Irvine Blvd., Irvine, CA 92713; (800) 999-4273, (800) 457-7777 (dealer referral service).

List Price: With 1MB RAM, one 1.44MB 3.5-inch floppy disk drive, double-scan CGA liquid crystal display, parallel port, serial port, DOS 3.3 in ROM, PC-Kwik PowerPak, \$1,699; with additional 1MB silicon RAM card, \$2,398; with 2MB silicon RAM card, \$2,898. Optional 2,400-bps modem, \$349; carrying case, \$99; spare battery, \$79.

In Short: A machine that's slightly larger than a notebook, with a great display and keyboard. A winner if you need a floppy disk drive but won't miss a hard disk.

CIRCLE 632 ON READER SERVICE CARD

PORTABLES

8086/8088-BASED

ZENITH DATA SYSTEMS

Zenith MinisPort

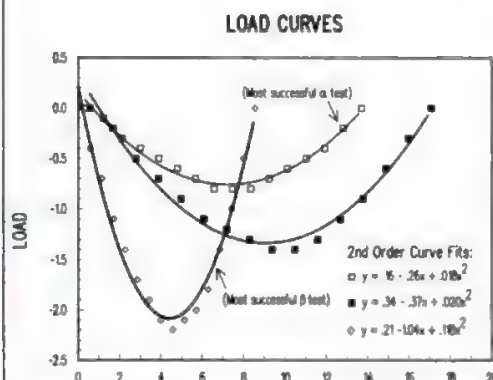
by Abe Rosner

At first glance you may be impressed with the Zenith MinisPort's sleek, succinct design, seemingly an ideal traveling techno-

crat's companion. This 8-MHz 80C88 notebook computer, with backlit CGA display, a 720K floppy disk drive, full-size keyboard, 2MB battery-backed RAM-disk, a 1,200 bps internal modem, and a 1.25- by 12.4- by 9.8-inch profile seems wonderful. In a vacuum, the tested \$3,515 MinisPort has plenty of merit, but in the evolving laptop market, the competition has passed by this portable.

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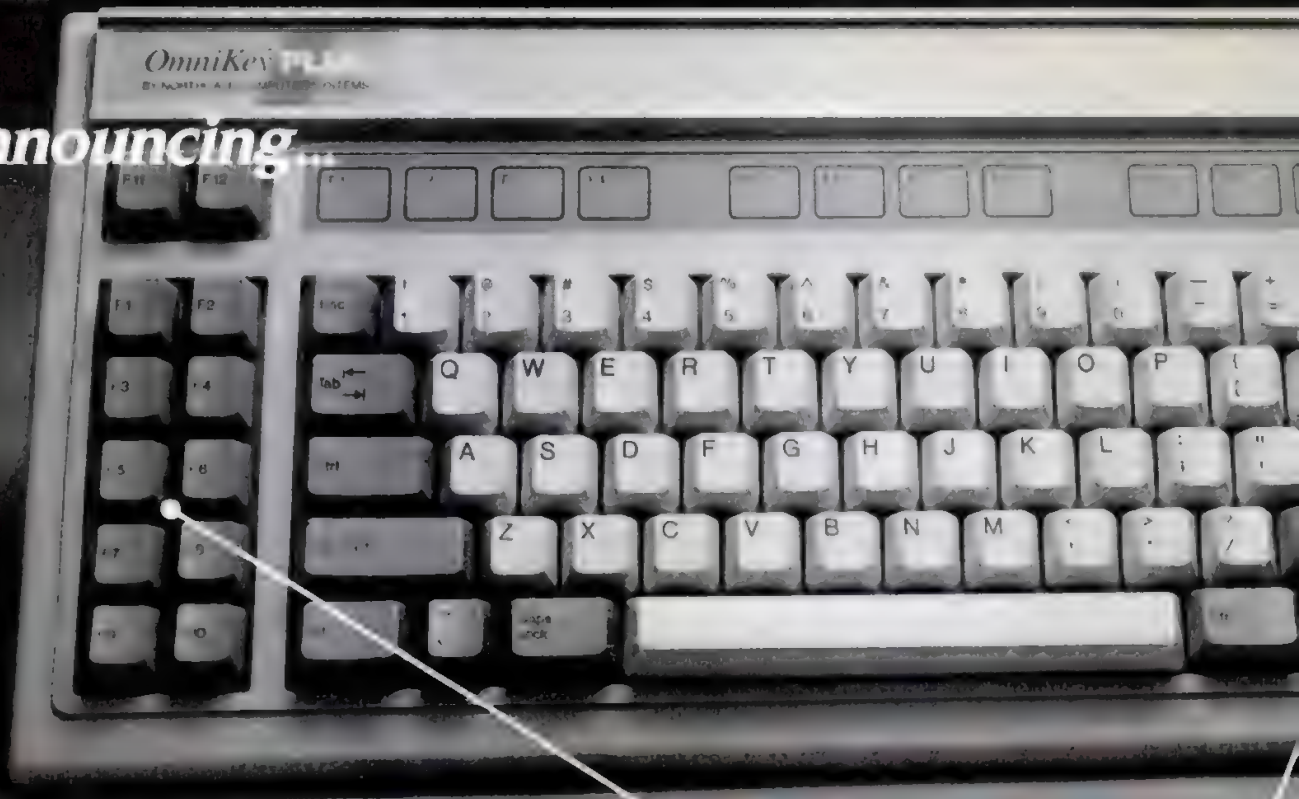
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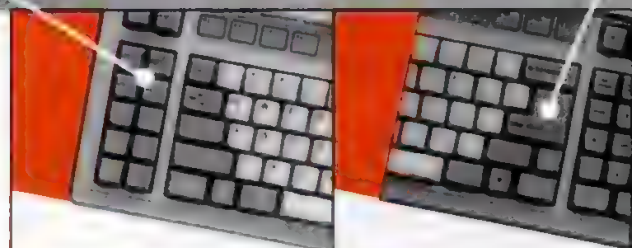
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PORTABLES

8086/8088-BASED

shell reveals the MinisPort's 8.5- by 3.25-inch transfective liquid crystal display. Despite being a full 80-character by 25-line backlit display, the screen was poor. Due to the exaggerated proportions of the MinisPort's display, the aspect ratio is a disappointing 2.8, one of the worst of the 73 portables in this issue (a normal desktop monitor has an aspect ratio of 1.33). Graphical images appear flattened. The display does work better than most other backlit LCDs in bright sunlight because of Zenith's unique transfective LCD technology, but images are faded when there is

The MinisPort is
designed for the
traveler who needs a
sleekly built unit to
fit inside a briefcase
or portfolio with
room to spare.

less ambient light, despite the MinisPort's adjustable backlighting.

Another drawback is the 720K floppy disk drive. Unlike the Compaq LTE and the Toshiba T1000SE, the MinisPort's floppy disk drive takes nonstandard 2-inch MiniDiskettes, which come in boxes of ten for \$99. Zenith has pledged to stock the diskettes at every location that sells the MinisPort, but the availability of these disks will remain limited.

To swap files with your desktop PC, Zenith includes a self-cloning file transfer program in ROM called *FastLynx LX*, which is easy to use. The necessary serial cable, along with a box of the 2-inch MiniDiskettes and a leather slipcover for the unit, come in a \$139 start-up kit. Other alternatives are a \$399 AC-powered external 360K 5.25-inch floppy disk drive, and Zenith's 720K 3.5-inch 720K external unit, which came with the tested system and runs on the MinisPort's battery.

The keyboard features full-size, normally spaced keys, including the cursor and function keys. Despite the short key

FACT FILE

**Zenith MiniPort**

Zenith Data Systems, 1000 Milwaukee Ave., Glenview, IL 60025; (800) 553-0331.

List Price: With 1MB RAM, 720K 2-inch floppy disk drive, CGA transfective liquid crystal display, parallel port, serial port, DOS 3.3, FastLynx LX, \$1,999; with 2MB RAM, \$2,799; with external 720K 3.5-inch floppy disk drive, 1,200-bps internal modem, start-up kit (including 10 MiniDiskettes), additional battery, \$3,515. 360K 5.25-inch external floppy disk drive, \$399; carrying case, \$59.

In Short: A functional 5.9-pound notebook computer. The MiniPort offers the advantage of long battery life on removable battery packs and a full assortment of I/O ports. It suffers from a small, hard-to-read display and non-standard storage media.

CIRCLE 633 ON READER SERVICE CARD

travel, the keyboard is comfortable to type on compared with other notebook-class computers. There is no disorientation, since the keyboard is laid out as expected. The Enter key is oversized, and the Home, End, PgUp, and PgDn keys do not need to be used in conjunction with other keys.

On the 1MB RAM units, 640K is provided for DOS, which resides in ROM, with 360K left on the battery-backed-up silicon disk. An additional 1MB silicon RAM card provides a usable 1.36MB RAMdisk. These silicon cards are backed up by nonrechargeable lithium batteries, so information is safe even when the rechargeable nickel cadmium system battery is drained or exchanged. When the 80-hour lithium battery dies, the information stored on the silicon disk is lost.

The MiniPort is a well-built computer designed for the traveler who needs a sleek unit designed to fit inside a briefcase or portfolio with ample room to spare. But with the 2 or 3 extra pounds this system has over its primary competitors and the small display, the MiniPort does not compare well overall with other notebook machines in its class.

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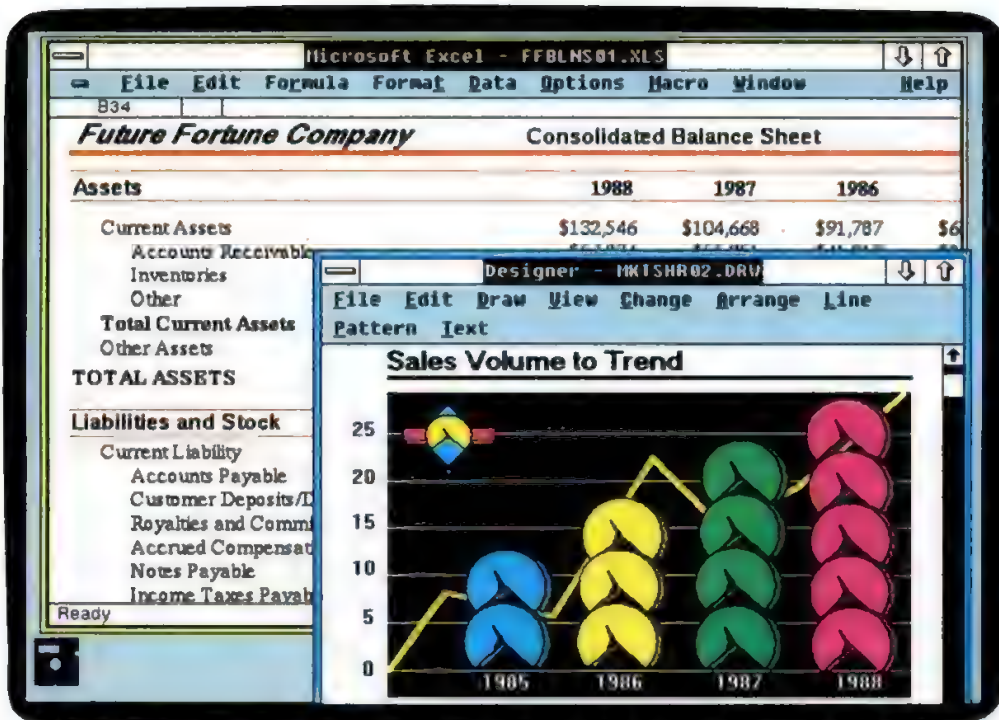
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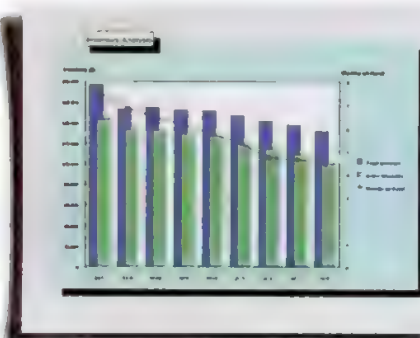
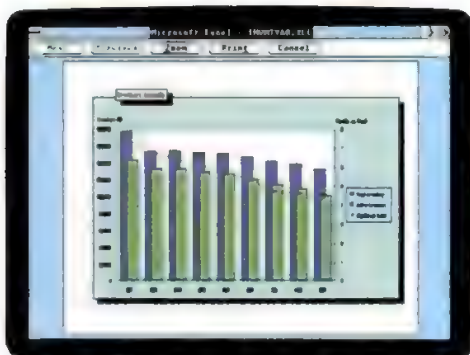
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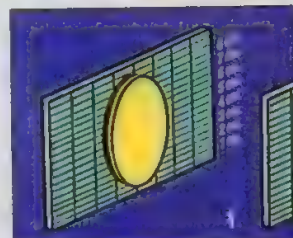
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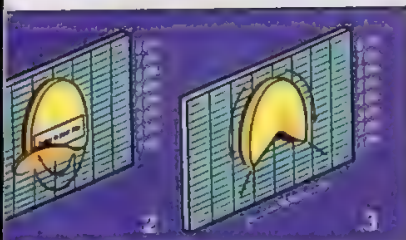
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It has been roughly 68 years since FFC last created new fortunes. But in light of the new logo and the whole new look brought to the company in the past year, the board of directors has unanimously voted to replace the old fortunes. President Jim Dearing explained, "As we exit the 1980's, people no longer believe in the same old lines, it's time to change".

e Fortune Teller

1989

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CIRCLE 294 ON READER SERVICE CARD

by
Pete Maclean

Lab Notes

Connecting laptop computers to networks of all kinds—PC-, mini-, and mainframe-based—is a major and urgent concern for corporate PC managers and MIS departments. Even home-based PCs need to tie in, as strong sales of remote-access software indicate. This Lab Notes column will take a close look at the issues involved in laptop connectivity. We'll focus first on connections to LANs and then turn to the IBM mainframe and mini-based host environments.

SERIAL PORTS OR SPECIAL HARDWARE?

PC communications can be divided into two basic groups: those that use conventional serial ports, and those for which some specialized port must be added on. Serial port communication is flexible and inexpensive, but it is limited in speed to a few thousand bits per second. It is also constrained by the fact that standard serial ports can transmit and receive information only asynchronously. If significantly higher speeds are required, add-on communications gear is generally necessary. Add-on equipment is also needed to access host machines—notably those bearing IBM labels—that insist on using synchronous communications.

All laptops come equipped with serial ports and can handle asynchronous communications as easily as desktop PCs. Because most laptops are not designed to accommodate expansion cards, however, they cannot easily be outfitted to handle high speed or synchronous communications. There are, fortunately, a number of ways around this obstacle, most of which involve expanding the role of serial port communication.

The procedures for establishing a remote connection to a LAN are the same for both laptop and desktop PCs. Thus, although the following discussion will be presented from the point of view of laptops, it applies equally to establishing remote connections with desktop machines. In both cases the physical connection can be exactly the same: normally a dial-up

Extending the Local Area Network to the Laptop Computer

■ The need to connect the growing number of laptop PCs to LANs, mainframes, and minis has produced a wide variety of solutions.

modem link. There are two fundamentally different methods of making this connection, distinguished by the software involved and the type of relationship that is established between the remote PC and the network.

REMOTE ACCESS SOFTWARE

The first type of connection is achieved by means of products such as *pcANYWHERE III*, *Carbon Copy Plus*, *Close-Up*, *CO/SESSION*, *Remote2*, or *PC Magazine's* own *PCREMOTE* utility (see our January 16, 1990 issue). All of these belong to a product category that is usually identified as remote-access or remote-control software. Briefly put, this kind of software links a pair of PCs in such a way that the user of one has control of the other. Such a connection can be used not only for LAN access, but is also suitable for remote equipment diagnosis.

More specifically, remote-access software allows the keyboard and monitor of the remote PC to function as the keyboard and monitor of the host machine. A modem link between host and remote sites is established, and the telephone lines act as an extension cord between the host ma-

chine and the remote PC's keyboard and monitor. There is no standard terminology for identifying the roles of the two connected PCs. Generally, the decentralized machine is referred to as the terminal—or remote—PC, and the other is referred to as the host PC. The way the two work together is very much like that of a multiuser system in which the user is connected to a host computer through a terminal.

Remote-access products consist of two programs, one for the host and one for the terminal. The host portion is a memory-resident module that periodically transmits whatever data is needed to keep the remote screen updated. It also receives characters from the remote keyboard, making them appear as if they were typed locally. The terminal, or remote, software is simply a specialized terminal emulator. When the remote user enters a command to run a program, that program is actually loaded and run on the host, though it appears to be running on the terminal. All of the products in this category use error-correcting protocols to transmit screen and keyboard data, so even with a bad connection there need be no worry about transmission errors.

For remote access to a LAN, you install the host software on a client PC equipped with a suitable modem. The general scheme is shown in Figure 1. When a remote user dials in he can do anything that can be done on the host PC. Normally the host PC can support only one terminal at a time, although in conjunction with such programs as *DESQview* there is some possibility of supporting two or more. Novell, for example, offers a product called

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NetWare Access Server that integrates special versions of *pcANYWHERE III* and *DESQview* to support up to 15 concurrent remote users on a 386-based PC.

The beauty of using remote-access software to connect to LANs is that the necessary products are available inexpensively off the shelf and—while there are no absolute guarantees—can be expected to work with any PC network. Furthermore, the better packages offer important extras, such as password-based security and file-transfer capabilities. Note that file transfer between the remote PC and the host PC effectively means file transfer between the remote PC and any file server on the LAN.

NETWORK SOFTWARE

The second way to make the remote LAN connection involves running a version of the network operating system (NOS) on the remote PC or laptop. The distant machine then connects to the LAN much as any other station would, except that the physical connection is a telephone link rather than a direct cable. This lets the remote PC take full advantage of the LAN software. Such an arrangement, shown in

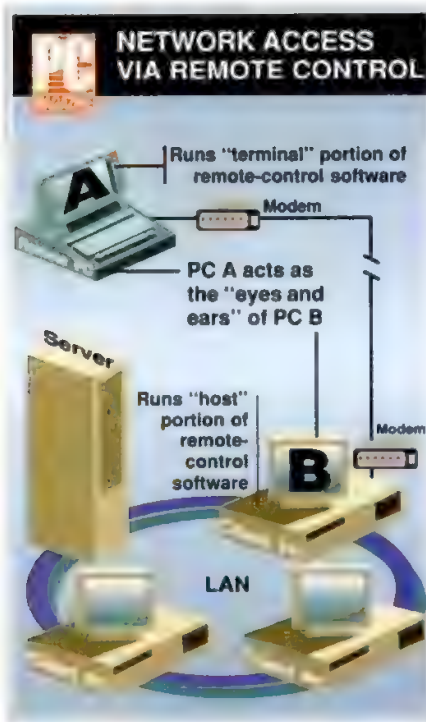


Figure 1: Using remote access software, a laptop accesses a LAN by controlling a PC connected to the network.

Figure 2, generally requires support by the network operating system vendor. All the major vendors furnish that support, but some smaller companies may not.

Different vendors have their own ways of connecting remote stations to the host network. The system component that supports the modems for incoming calls may be a file server, a bridge, an asynchronous communications server, or a client. To the remote user, of course, it makes no difference.

As a general rule, it is wise to avoid putting modems on a file server unless they are serviced by a coprocessor of some kind. The use of regular serial ports in this situation would put an intolerable interrupt load on the server. Banyan's Intelligent Communications Adapter (ICA) is an example of a coprocessor designed for this purpose.

WHAT'S THE DIFFERENCE?

From the point of view of the remote user, the two methods of remote access elicit essentially similar keyboard and video response. In terms of performance, however, a little thought should lead you to the conclusion that one method or the other will be faster depending on the application being run.

Performance differences are generally related to the data that has to travel over the modem and phone link. (Remember, this link is the same under both methods.) Consider two extreme cases, then. First, imagine running a graphics application that reads a small drawing-definition file from a file server and uses it to display a complex picture on your screen.

The first method of remote connection would be very inefficient in this situation, for all of the pixel-by-pixel information that defines the image would have to be sent through the bottleneck of the telephone link. The direct network connection would be significantly better in this case, for then only a small amount of data—the contents of the file—would have to flow through the bottleneck.

For the second case, consider a program that reads several thousand records from a database stored on a network server and generates a one-page report. Remote network access is to be preferred in such a situation, for the bulk of the data involved—the set of database records—is sent over the fast link, the LAN, processed locally on the network, and the only data that is then transmitted across the phone link is a mere page of text.

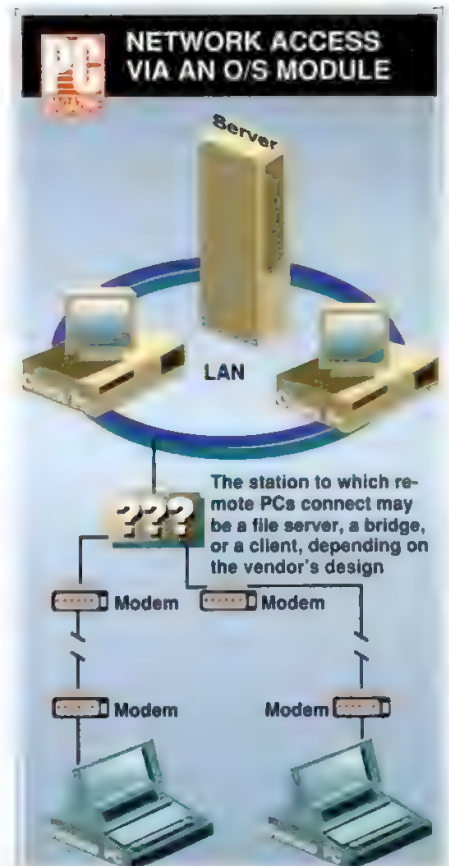


Figure 2: An alternative offered by most major vendors is to equip the remote laptop or PC with a version of the network software so that it becomes a fully capable network station, though connected by modem rather than by cable.

Such differences in access needs are the reason why, as networks expand into all areas of a company's business, many organizations offer both types of connection. Generally, individual users will require one or the other method, but seldom both. It then becomes the responsibility of the network manager to set up the user appropriately.

A THIRD ACCESS METHOD

NetWare users have yet a third means of remote LAN access. This third possibility, which should be considered when the amount of remote access is heavy, consists of using PC-on-a-card products that are plugged inside an *Advanced NetWare* server to endow the network with "dedicated" dial-in stations. There is no generally accepted name for this class of product; some call them slave PCs, others call them LAN-in-a-box. A variety of such products was reviewed in the August 1988 issue of *PC Magazine* under the title "Making Connections: Clustered CPUs."

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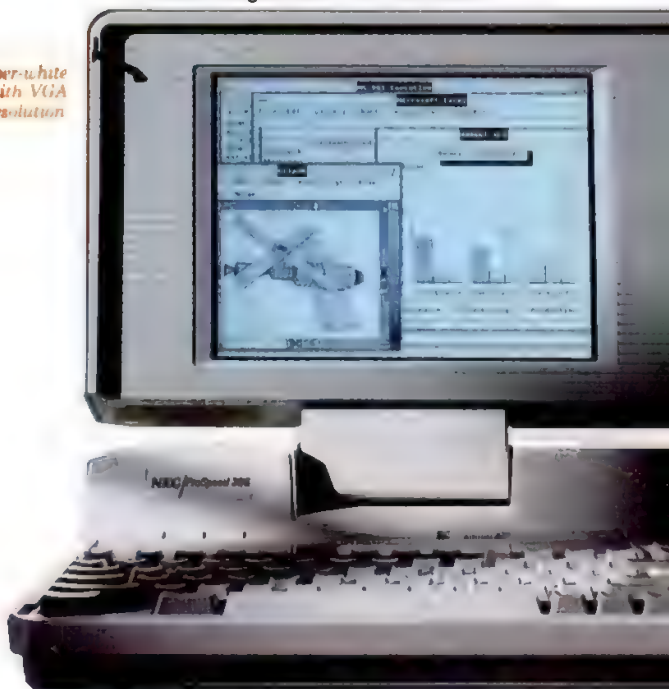
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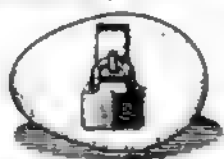
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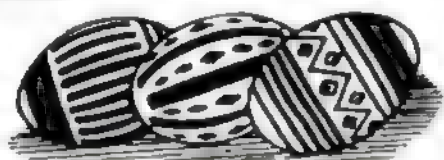
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Cubix, Alloy, and others sell cards that house the essential components of one, two, or even four diskless PCs: processor, memory, and sometimes a COM port—all on a single card. The only thing missing is a power supply. Each card-based PC is completed by the addition of a PC-compatible terminal—that is, an asynchronous monitor and keyboard combination that behaves exactly as do the monitor and keyboard on a PC. By plugging in a modem and phone line instead of an asynchronous terminal, PCs at remote locations can dial in. For the remote user this works very much like the remote-access method discussed. Powerful multiuser bulletin board systems have been set up using this type of product.

There are also card-based PCs from companies such as ADC that operate with a real PC monitor and keyboard rather than a terminal. These card-based models can be fine choices for supplementing local LAN access but they offer nothing special for remote access.

LOCAL ACCESS TO LANS

Local LAN access is a thorny problem for laptop users since most laptop PCs can't physically accommodate network interface cards. While some "laptops" that are too big to put on your lap have standard expansion slots, most true laptop machines have at most one small proprietary slot. There are, however, many products designed to assist in hooking these smaller laptops to networks.

I do want to mention, however, that absent a better solution, you can always use the remote-access methods discussed above for on-site connections. By using a null-modem cable instead of a pair of modems, a laptop can be plugged in directly. With a direct connection of this type speeds of 19,200 bits per second or 38,400 bps are often attainable; the limit depends on the software used.

HANDLING MEMORY CONSTRAINTS

Making the actual link between laptop and LAN may not be the only hurdle in the way of gaining network access. If the method you select involves running the network operating system in the laptop, there may also be a memory problem.

Every DOS system is subject to the infamous 640K barrier. The 640K memory

limit is actually a result of the architecture of the original PC; it has been perpetuated rather than (as many think) imposed by DOS. All the same, its consequence is that with the network software plus the remote-communications software loaded, there may be too little RAM left to run large applications.

There is no magical way around the limit, but there are plenty of tricks that suffice in specific circumstances. For 386-based PCs, software alone can help. This can provide an easy solution for many of the newer laptops. Both Quarterdeck's *QEMM-386* and Qualitas's *386-to-the-Max* can free up space below 640K, for example.

PCs based on the 286 or earlier processors will, unfortunately, require some extra hardware. As mentioned previously, this is a problem particularly for laptops because of the limited amount of space available for add-in cards.

One popular solution to RAM-cram in 286-based systems is the All Charge Card, which is manufactured by All Computers. This card plays some addressing tricks so that memory-resident programs, including many NOS modules, can be loaded into extended memory.

The All Charge Card is not a regular expansion board; it is plugged not into an expansion slot but into the socket that carries the 80286. It is certified to work with any 286 running at 12 MHz or less and, in practice, the All Charge Card also works in a number of systems with 16- and 20-MHz chips.

Before considering the All Charge Card for your laptop, however, check whether the processor is socketed or soldered. Unfortunately, in quite a few laptop machines the chip is soldered into place, which leaves very little hope. The moral is to carefully investigate the underlying design of any laptop that you might want to use on a network.

The other problem is finding a space for the card. As the name suggests, it's only about the size of a charge plate, but most laptops have precious few nooks and crannies. I have succeeded in squeezing an All Charge Card into my Toshiba T3200, but people with other 286 models may not be so lucky.

REMOTE IBM HOST ACCESS

As you've seen, connecting up to a PC-based network is not really very difficult. Making connections to most non-IBM host machines—such as DEC VAX sys-

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terms—is also relatively straightforward: you can do it with a simple communications package (*ProComm*, *CrossTalk*, or the like) set to emulate a terminal, such as a DEC VT-100. If your laptop lacks a hard drive, you'll want to look for a terminal-emulator program that occupies little disk space. *Smartcom III*, for example, may be a dream communications package for desktop users with megabytes to spare, but you'll probably find that you can't squeeze a copy onto one diskette.

Access to IBM machines, however, is not as easy. For the rest of this Lab Notes we'll turn to the problem of making connections from laptops to IBM mainframe and mini-based hosts. Only a very small percentage of IBM mainframe systems support asynchronous terminals. For the few that do, of course, a PC running a terminal emulation program will suffice. Unfortunately, the mainstay in IBM mainframe installations is the ubiquitous 3270 family of terminals.

Making a laptop—or any PC—look like a 3270 involves more than just software and a PC modem. The same is true for connecting to IBM's System/36, System/38, and AS/400, each of which exclusively supports a proprietary class of terminals known as the 5250 family. As indicated in Figure 3, there are three basic approaches to endowing a PC with 3270 or 5250 capability: direct emulation, protocol conversion, and a hybrid of the two.

In a direct emulation system, the PC is made to disguise itself as a 3270 or 5250 workstation, with which the IBM host is prepared to communicate. This always requires adding at least some hardware to the PC, primarily to furnish a suitable communications interface. Direct emulation delivers the best performance and the fanciest features: multiple terminal sessions, memory-resident operation with hotkeys, a printer session, file transfer, APIs, keyboard reconfigurability, and so on. But the cost is high and the add-on hardware is unwieldy for laptops.

Moreover, this approach also involves using a synchronous modem. While asynchronous modems that will fit into laptops or even into shirt pockets are available, their synchronous cousins are still distressingly large. Given future emulation products designed specifically for laptop machines (along the same lines as pocket

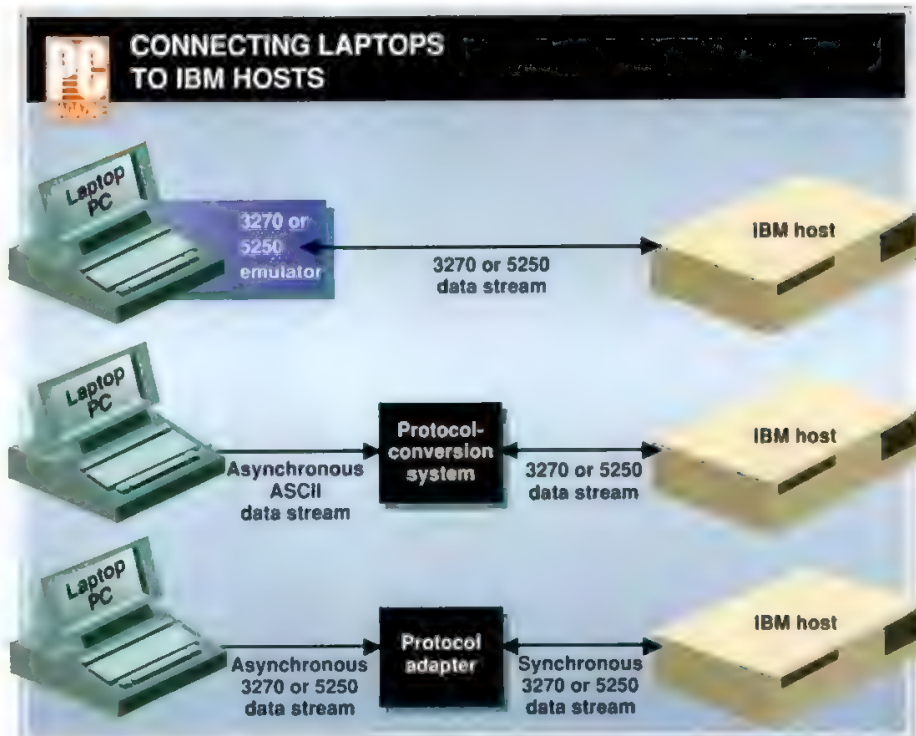


Figure 3: Direct emulation, protocol conversion, or use of a protocol adapter are the three basic ways to provide a PC with 3270- or 5250-style access to an IBM host.

LAN adapters), this option might become attractive, but such products are in their infancy. Today, however, the direct emulation method requires a clumsy expansion chassis and a bulky external modem that fits uncomfortably with the idea of a laptop computer.

In the second approach, protocol conversion, the PC emulates an ASCII terminal, and somewhere in the chain of devices that link the PC to the host a conversion is performed between the asynchronous ASCII data stream and a 3270 or 5250 data stream. Protocol converters of various kinds have been around for many years; indeed, they antedate PCs, having been invented to support IBM-host access by real ASCII terminals such as the DEC VT-100 and the IBM 3101.

Protocol converters have the advantage that most can be accessed not only via PCs, but from Macs, other computers that can emulate a respectable ASCII terminal, or from actual VT-100s, 3101s, and the like. This, in turn, leads to another advantage: low cost. The laptop runs an ordinary, inexpensive communications program, such as *ProComm* or *Telnet*, and the bulk of the dollars go into a protocol converter box that can easily be shared among many users. For light-duty application needs, protocol conversion may be a satisfactory solution for laptops.

One of the problems with protocol converters, however, is that they treat your PC as if it were a dumb terminal. When using this approach you typically can't ask for multiple sessions or APIs, and even file transfer may be next to impossible. Another limitation of many protocol-conversion products is that there is no error control on the path between the protocol converter and the PC.

For remote connections using a protocol converter, therefore, you should consider also using error-correcting modems. Although most internal modems sold for laptops lack error-correcting capability, one new product, Touchbase Systems' WorldPort 2400/MNP, is a 7.5-ounce battery-powered pocket modem that serves the purpose admirably. In fact, it provides not only error control, but Level 5 MNP compression as well. This means that on a 2,400-bps connection you may see effective data-transfer rates as high as 4,800 bps. At the host end, compatible MNP modems of a desktop or rack-mount variety, from Microcom or one of many other companies that offer them, would complete the setup.

The third approach represents a hybrid of the two already discussed. In this system a product—which for want of a generally accepted term I'll call a protocol adapter—converts host data streams at a

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low level so that they can be delivered to PCs over asynchronous connections, leaving the higher-level protocols intact for interpretation at the user's machine.

More specifically, SNA (System Network Architecture) messages are sent to and from the host using SDLC (Synchronous Data Link Control) and to and from the PC using some other link-level protocol that is suited to asynchronous transmission. This puts the SNA "engine" (as some vendors call it) in the PC, while allowing the PC to communicate via standard asynchronous modems. When well implemented, this method promises the features of direct emulation with the ease of protocol conversion at a cost that lies between the two.

Products in this class include the software and hardware necessary to set up the protocol adapter, together with an emulation program for the PC. A performance penalty is inevitably incurred by hauling cumbersome SNA messages over asynchronous links, but in the better products of this type that loss is offset by the provision of data compression. External compression devices, such as modems with compression facilities, can be used where that capability is lacking in the product itself. It should be noted, however, that it is definitely *not* a good idea to try to double up on compression—by having it done by hardware when it is already done by software, for example. The net result may be to *increase* the quantity of data over that achieved with a single source of compression.

CONNECTING TO IBM MAINFRAMES

Figure 4 diagrams some of the many ways in which a laptop can be connected, 3270-style, to an IBM mainframe. Both protocol-conversion and protocol-adapter techniques are represented.

At the center right in the diagram is a standalone protocol converter. This device acts as a front end to the host and performs conversion for either real ASCII terminals or for PCs emulating them. Suitable products would include IBM's 7171 and the Hydra, from JDS Microprocessing. These are large, powerful, and expensive units that are especially worthy of consideration when a large number of real ASCII terminals and of PCs emulating them must be supported.

Above the standalone protocol converter is a 3174, one of IBM's latest 3270-family control units. As shown, the 3174 is equipped with an Asynchronous Emulation Adapter, an option that enables it to support ASCII terminals. The adapter, in fact, makes the 3174 a 3270 controller and protocol converter in one. The unit depicted is directly connected ("channel-attached") to the mainframe, but, depending on the model, it may alternatively be possible to connect it locally via a Token-Ring LAN, remotely via a telephone link, or via an X.25 circuit.

The same 3174 is also shown attached to a desktop PC equipped with a 3270 emulator and to a LAN gateway. The 3270 emulator is a product in the class of DCA's popular IRMA product, a combination of hardware and software that enables the PC to emulate a 3278 or 3279 terminal directly and to attach to a control unit via coax. The power of many such emulator products can be harnessed remotely using one of the remote-control products (such as *Carbon Copy Plus*, *pcANYWHERE III*, and so on) mentioned above.

Although this arrangement is not usually thought of as constituting a protocol converter, it is effectively just that. The laptop emulates a PC-style terminal, and the combination of programs in the desktop PC and the 3270 card act as a protocol-conversion system. While remote use of PC-based 3270 emulators is usually possible, you do need to be careful to ensure compatibility between that unit and whatever remote access software might be used.

The 3270 gateway connected to the 3174 might be emulating a multisession terminal or a 3299 multiplexer. In either event, it is providing 3270 terminal and printer sessions for use by other PCs on the LAN. These sessions should be equally available to dialed-in PCs whatever the method used to establish the remote connection.

Since many gateways operate using NetBIOS and are thus independent of the network operating system, it may even be possible to gain remote access to a gateway with a remote NetBIOS link. IBM sells such a product, and I know of other similar utilities currently under development. What is particularly appealing about a remote NetBIOS is that it allows a dialed-in laptop or desktop PC access to any network services that depend purely on NetBIOS.

For LANs that use NetBIOS-based op-

erating systems, such as the IBM *PC LAN Program* and Artisoft's *LANtastic*, this method provides access to everything the LAN has to offer. For other networks, such as those based on *NetWare*, remote NetBIOS hook-ins might allow access to gateways while precluding access to the file- and printer-sharing services of the network operating system. Some access restriction may be desirable in particular situations, either for security reasons or because it may perhaps be less expensive to provide than full-scale access.

Moving further (counterclockwise) around Figure 4, you come to an IBM Communications Controller. Most mainframe vendors sell such devices, generically called front ends, to handle telecommunications for the host. IBM's front ends have designations such as 3705, 3720, 3725, and 3745. Another standalone protocol converter is shown hooked into that.

While few companies manufacture channel-attached protocol converters, many make models designed for remote connection. Micom and Renex are prominent names in this field. A PC can do the job too if equipped with a remote 3274 emulator and an RS-232-based cluster option. Normally connected by synchronous modems over a leased or dialed telephone line, a protocol converter of this sort can also be locally connected by means of a synchronous modem eliminator.

AdaptAsync, from Network Software Associates (NSA), is representative of the new breed of protocol-adapter systems that deliver SNA data packets asynchronously to PCs. It fits into the picture in the same manner as does a protocol converter attached to the Communications Controller. It differs physically in that it is built into a PC. The laptop runs the same emulator program that works with NSA's coax cards, but it is configured with a driver for the async connection. In this way, NSA supports not only 3270 operation, but also 3770/RJE, LU6.2/APPC, and SNA's do-it-yourself LU0 connections.

The next option shown for 3270 access is in-the-host protocol conversion. Front ends are usually configured to support synchronous connections, but they are entirely capable of handling asynchronous links as well, thus allowing laptops to dial in directly. This form of connection demands that the conversion be done in the host itself, by a product such as *SIM* (from SIMware) or one of the *Relay* family offered by Microcom Software. Products of this type inevitably add to the processing load of the

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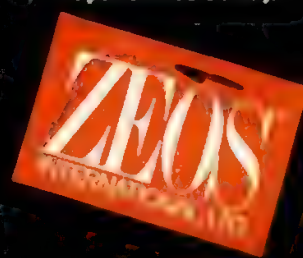
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host, however, which is a factor to consider, but they can often prove to be very economical. Both of the products mentioned above also provide software for the PC end, which puts them into the protocol-adaptor category.

Below the Communications Controller, and drawn to a rather different scale, is a packet-switching network (PSN). (Why these are always drawn as clouds, I don't know, but it seems a good idea.) Remote

access via a PSN is attractive for hosts that must support a large number of geographically dispersed users, especially when providing international access.

For IBM hosts, some PSNs—among them Telenet and TYMNET—can provide protocol-conversion services within the network. To go with its ASCII-3270 translation service, TYMNET offers a sophisticated PC communications package, *EZTYM*, that supports multiple sessions (via X.PC) and such other goodies as support for IBM's IND\$FILE file-transfer system. It also boasts a powerful script language. The regular version of *EZTYM* is so big

that it can be used only on a PC with a hard disk, but a specially tailored dual-floppy version is available just for folks with laptops.

Another option, targeted largely to hosts on X.25-based networks, is Packet/3270 from Packet/PC. This box sits between the IBM system and a PSN and not only performs the needed conversions but supports dial-in users, as well.

The last option shown, at the bottom right of the Figure 4, takes advantage of a direct Token-Ring connection to a main-frame. This works much like the gateway described previously, but it offers a more

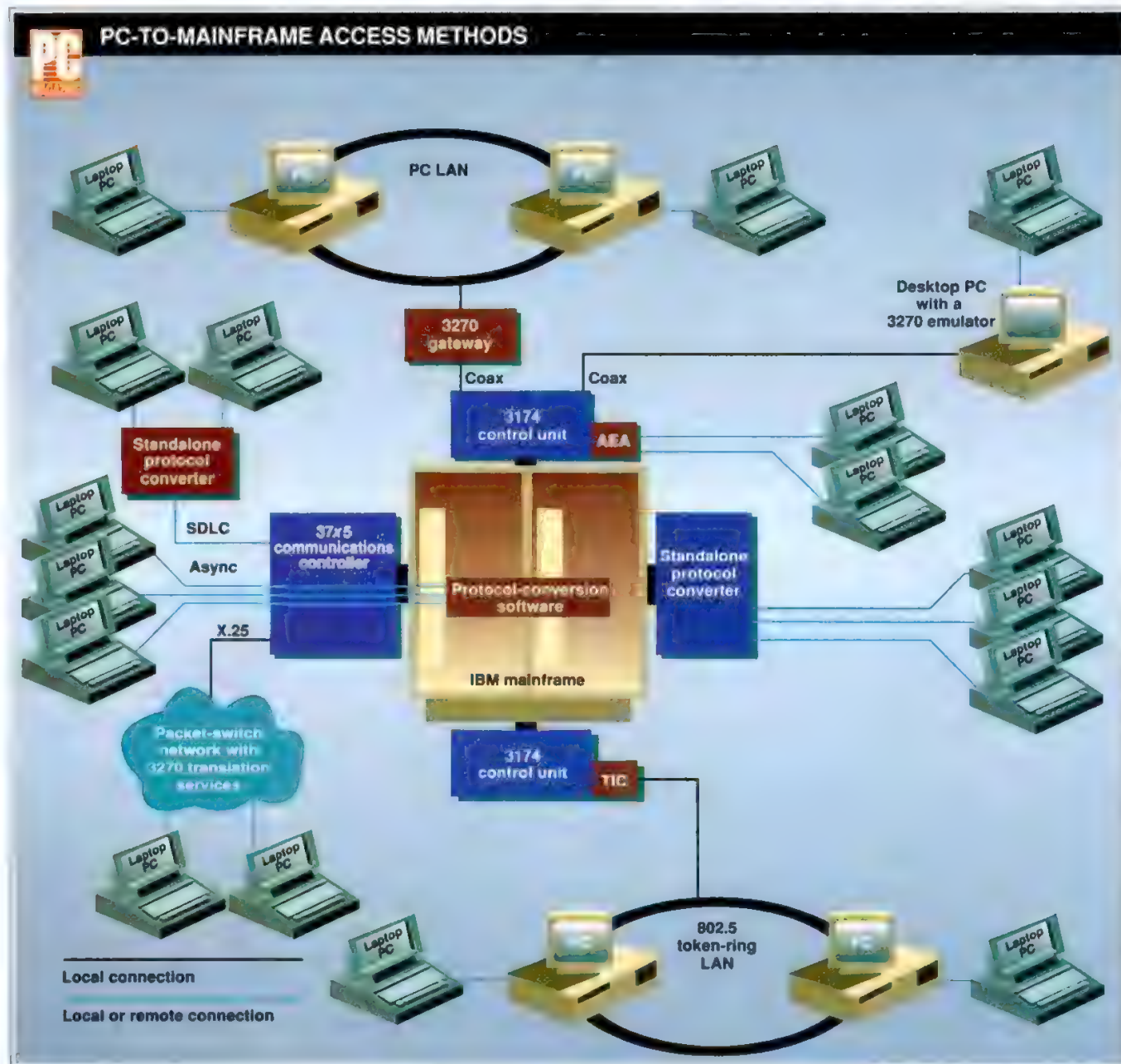


Figure 4: There are various ways to give laptop PCs 3270 access to an IBM mainframe.

Lab Notes

powerful means of mainframe access. In the case shown, a 3174 is equipped with a Token-Ring Interface Coupler (TIC) that enables it to provide a connection to the LAN on the mainframe's behalf. Laptops connect in, once again, by any means that enables them to use the services of the network.

CONNECTING TO IBM MINIS

The principles described above apply equally to providing laptops—or PCs in

general—with 5250-style access to IBM System/36, /38, and AS/400 machines. PCs, indeed, are considered the standard workstations for these popular midrange systems. IBM's own *PC Support* software offers PC users not only file transfer, but also virtual disk drives on the host. All such services, however, are built on the bedrock of 5250-style terminal connections.

Predictably, direct 5250 emulation always offers the most performance at the highest price. Unfortunately, this route is also attended with the greatest inconvenience. As with the mainframes, protocol converters permit access via ASCII-termi-

nal emulation. But again, the most promising solutions are those hybrid systems that let the PC do the high-level part of the 5250 emulation while communicating asynchronously.

As schematized in Figure 5, there are products in the 5250 world to match most of those listed for 3270 environments. Host-based protocol conversion is missing, and PSN methods are only just now beginning to appear. Standalone protocol converters are available from Local Data, Renex, Wall Data, and others. Twinax-attached emulators capable of remote access are sold by such companies as Emerald Systems. Packet/PC offers Packet/5250, a

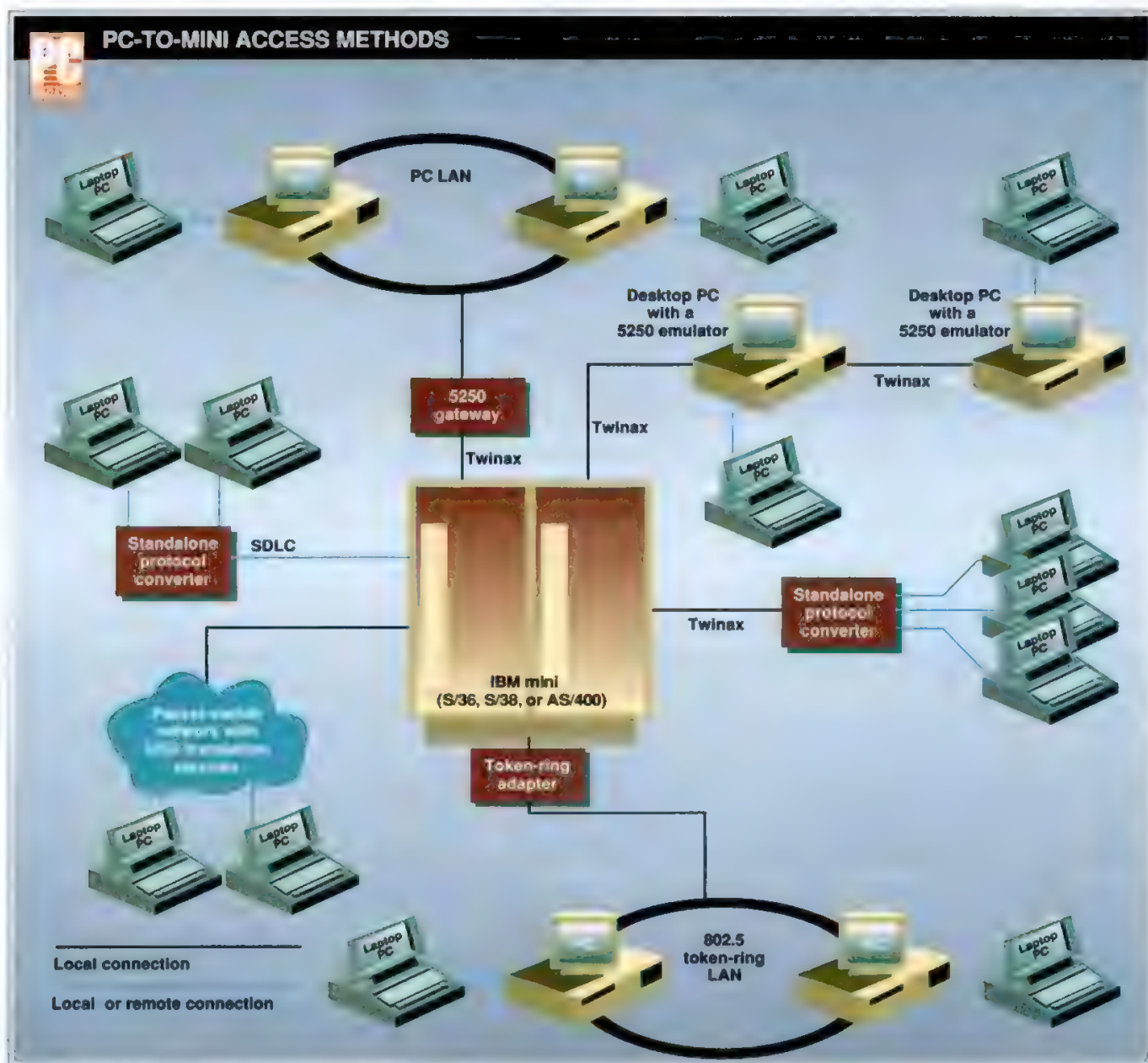


Figure 5: A similar flexibility is available for providing 5250 access to IBM minis.

Lab Notes

protocol adapter that serves as an X.25 front end for access via PSN.

Both for 3270 and 5250 needs, I must caution readers to stick with well-proven products. That may be good advice anywhere, but it needs particularly strong emphasis here. Emulating a 3270 or 5250 is

no easy task—I know from having actually worked on several products—and immature or off-brand products may well slip up in handling some feature that few people use but is vital to you.

It's characteristic of the IBM mainframe world that there are dozens of ways to do almost anything. This survey has covered the most practical and popular methods of host access, but there are many possible variations on the themes outlined

here. If you have discovered or are developing a new way to connect laptops to IBM hosts, we at *PC Magazine* would very much like to hear from you, and we invite you to contribute a reader submission.

THE FUTURE OF LAPTOP CONNECTIVITY

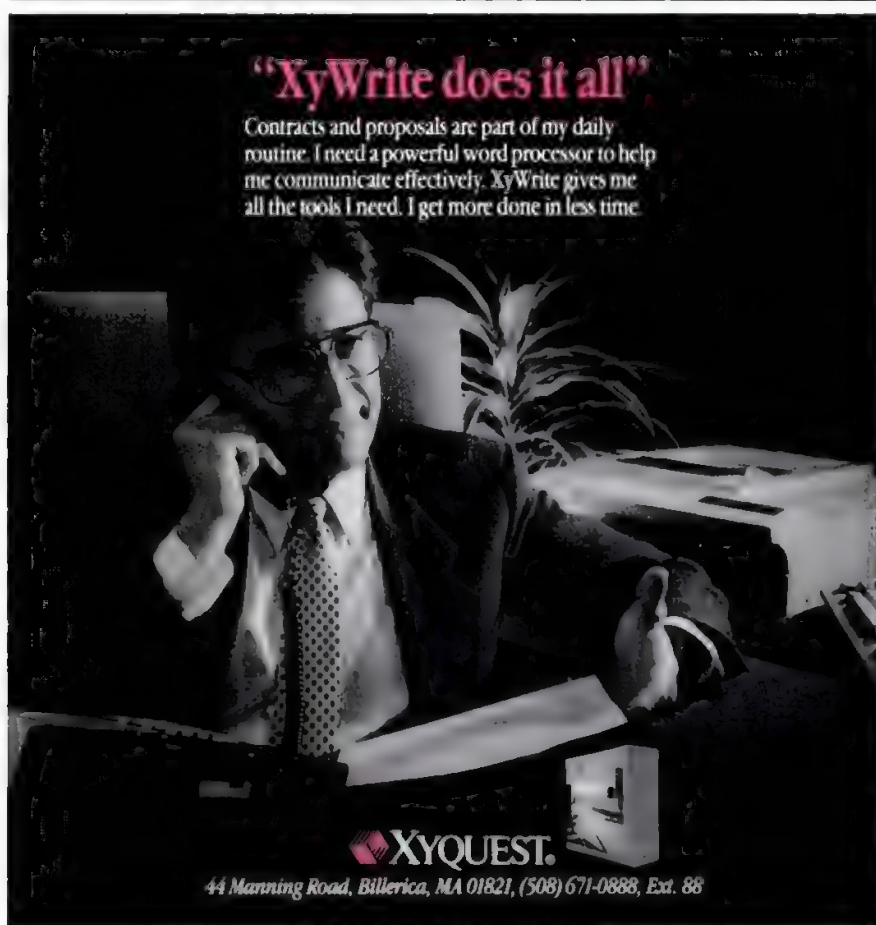
Press releases arrive daily about new screen technologies for laptops, new power systems, new storage devices—but what about connectivity developments? Will we see special SDLC adapters built for laptops? While I won't positively say no, the lack of any to date and the need for a synchronous modem make me doubt it. One can find SDLC cards with integrated modems, but these are inevitably full-sized and so crammed with components as to hardly be promising candidates for shrinkage to laptop dimensions.

You may be tired of hearing that ISDN is just around the corner. But it is, and it holds particular promise for laptops. An ISDN adapter would replace the SDLC card and synchronous modem combination. Those currently being shown are fair-sized cards, but we can expect technology to shrink them to a size that *could* be crammed into a laptop, perhaps (hope springing eternal) as standard equipment.

We are also beginning to see laptops equipped with radio-based communications. An example is the Agilis, which hooks into an Ethernet over the airwaves. Radio connections are limited in speed and distance, but they are nonetheless a boon for mobile applications. (The classic example is a network station mounted to a forklift truck in a warehouse.) I'm also hearing of laptops that incorporate cellular modems. We have cordless phones, why not cordless modems?

I dream of the day when I can have a Poqet, or similar 1-pound palmtop PC, boasting a 9,600-bps modem that links to a tiny telephone adapter by radio, plus a pocket Ethernet adapter that talks to a cable tap in the same manner. Cableless communication is the key not only for mobile applications but for restless folk like me who like to work while wandering around the office. Until such wishful thinking becomes reality, however, the methods outlined here should do the trick. ■

Pete Maclean, a Scotsman living in San Francisco, is a consultant who specializes in software development, training, and troubleshooting for computer networks.



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by
Ray Duncan

Power Programming

Arithmetic Routines For Your Computer Programs, Part 7

This column on the Intel 8087, 80287, and 80387 numeric coprocessors will be the last, at least for a while. These are very interesting and intriguing chips, but a deeper treatment of their programming would require discussion of numeric analysis, exception handlers, and other complex issues that only a huge amount of enthusiastic reader feedback could justify. I hope, however, that the information that has been presented here over the last few issues will encourage you to learn more about the capabilities of these powerful coprocessors and use them in your application programming.

Throughout this column "CPU" will denote any of the Intel 80x86 processors: 8086, 8088, 80286, 80386, or 80486. The term "coprocessor" will refer to any member of the coprocessor family: 8087, 80287, 80387, or the 80387 logic embedded in the 80486. I won't refer to specific models unless a statement does not apply to its entire family.

MORE ABOUT STACKS

In the last issue, I covered the basics of doing arithmetic on stack machines. Once the basics are mastered, you can use a number of tricks that take advantage of the stack architecture to speed up special cases of addition, multiplication, division, and raising numbers to powers. For example, to double a number that is already on top of the floating-point stack, you can write

```
fadd    st(0),st(0)
```

If the number resides in a variable, you can use the instructions

```
myvar   dd      0
.
.
fld     myvar
fadd    st(0),st(0)
fstp    myvar
fwait
```

In these examples, incidentally, I will

■ Shortcuts, rounding considerations, transcendental functions, and string conversions are the final topics in the discussion of Intel family coprocessor programming.

show the final synchronizing FWAIT instructions, but you should remember that the FWAIT is not necessary if your program performs another floating-point instruction before the CPU accesses the result in the variable. Of course, you could also have written

```
myvar   dd      0
.
.
fld     myvar
fadd    myvar
fstp    myvar
fwait
```

This alternative method, however, involves more references to memory, which increases the contention between the CPU and the coprocessor for the memory bus, and thus runs more slowly.

To square a number that is already on top of the floating-point stack, write

```
fmul    st(0),st(0)
```

Again, if the number resides in a variable,

then you can code:

```
myvar   dd      0
.
.
fld     myvar
fmul    st(0),st(0)
fstp    myvar
fwait
```

You can easily raise a number to a (small) power with in-line code or a loop. For example, to obtain the cube of a value, you can write

```
myvar   dd      0
.
.
fld     myvar
fld     st(0)
fmul    st(0),st(0)
fmulp   st(1),st(0)
fstp    myvar
fwait
```

Alternative coding for this operation is

```
myvar   dd      0
.
.
fld     myvar
fmul    myvar
fmul    myvar
fstp    myvar
fwait
```

Again, however, this form involves more memory bus traffic and address calculations, and therefore should be avoided. I

Power Programming

will discuss more general methods for raising a number to a power a little later on in this column.

The coprocessor's built-in constants can often be used to your advantage. To take the reciprocal of a number, for example, you can write

```
myvar dd 0
.
.
fld1
fdiv myvar
fstp myvar
fwait
```

As another simple example, let's consider the conversion of an angle in radians to an angle in degrees. The basic relationship between radians and degrees is expressed by the formula

$$360 \text{ degrees} = 2 * \pi \text{ radians}$$

If x is a value in degrees and y is a value in radians, therefore,

$$x = 360 * y / (2 * \pi)$$

So to convert an angle in radians that is stored in a variable into the same angle in degrees—leaving the result in the same

SAVE/RESTORE ROUNDING MODE

```
oldmode dw 0
newmode dw 0
.
.
fstcw oldmode
fwait
mov ax,oldmode
and ax,0f3fffh
or ax,00c000h
mov newmode,ax
fldcw newmode
fwait
.
.
(other calculations here)
.
.
fldcw oldmode
fwait
```

Figure 1: You must be sure to save and restore the coprocessor rounding mode when you put its code into a TSR or similar program. In this illustration, the current rounding mode is saved and then set temporarily to truncate.

COPROCESSOR TRANSCENDENTAL FUNCTIONS		
Instruction	Operation	Argument range
FPTAN	Partial tangent	$0 \leq X \leq \pi/4$ $ X < 2^{63}$ (80387)
FPATAN	Partial arctangent	$0 \leq X \leq Y \leq \text{infinity}$
FSIN	Sine (80387)	$ X < 2^{63}$
FCOS	Cosine (80387)	$ X < 2^{63}$
FSINCOS	Sine and cosine (80387)	$ X < 2^{63}$
F2XM1	$2^x - 1$	$0 \leq X \leq 0.5$ $-1 \leq X \leq 1$ (80387)
FYL2X	$Y \cdot \log_2(x)$	$0 \leq X \leq \text{infinity}$ $-\text{infinity} \leq Y \leq \text{infinity}$
FYL2XP1	$Y \cdot \log_2(x + 1)$	$0 \leq X \leq (1 - (\text{SQRT}(2)/2))$ $-\text{infinity} \leq Y \leq \text{infinity}$

Figure 2: The coprocessor family supports all of the above transcendental function operations. But those marked 80387 are available only on the 80387 or 80486, and not on the 8087 or 80287.

variable—you can use the sequence

```
myvar dd 0
int360 dw 360
.
.
fld myvar
fimul int360
fldpi
fadd st(0),st(0)
fdivp st(1),st(0)
fstp myvar
fwait
```

ROUNDING

The coprocessors support four rounding modes: round to nearest or even number ("banker's method"); round toward positive infinity ("round up"); round toward negative infinity ("round down"); and truncate ("chop"). The active rounding mode is involved when the result of a calculation does not fit exactly into the 80-bit floating-point format that is used in the coprocessor registers, or whenever a number is unloaded from the coprocessor stack into a shorter memory-resident data format.

The current rounding mode is determined by bits in the word in the coprocessor control register (see January 16, 1989 Power Programming, Figure 5). The default mode after coprocessor initialization with the FINIT or FNINIT instruction is the banker's method. To avoid unexpected and bizarre results, your application program should always either initialize the coprocessor or set the rounding mode explicitly. This is especially important when you

are using the coprocessor for integer arithmetic, because chop mode is symmetric with the rounding performed by the CPU's native divide instruction. The banker's method mode is appropriate only for floating-point operations.

The round-up or round-down modes are rarely needed, but they can be handy for estimating the degree of uncertainty in an extended calculation. You can carry out the entire calculation twice, first with round up selected and again with round down. Comparison of the two results will then determine the maximum potential error that is in the final result because of

Bits in the coprocessor control word register

set the current rounding mode.

rounding of intermediate values.

A final caution with regard to rounding: if you use the coprocessor in a TSR, device driver, or interrupt handler, you must be careful to save and restore the coprocessor rounding mode so that calculations by a foreground application will not be disturbed. For example, to save the current rounding mode and then temporarily set it to truncate, you could use the code shown in Figure 1. It is often not enough, howev-

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Power Programming

FALOG.ASM

COMPLETE LISTING

```

title FALOG.ASM Calculate Common Antilog on 80x87
page 55,132

; FALOG.ASM --- Calculate Common Antilog on 80x87
;
; Copyright (C) 1989 Ziff Davis Communications
; PC Magazine * Ray Duncan
;
; Call with: ST(0) = argument
; Returns: ST(0) = antilog to base 10
;
; Uses: CPU registers are preserved;
;       uses 3 cells of coprocessor stack
;
; Note: To obtain natural antilog, replace
;       "fldl2t" instruction with "fldl2e".
;
; Make sure coprocessor has been properly initialized
; with a previous call to INIT87!

_TEXT segment word public 'CODE'
    assume cs:_TEXT

oldcw equ word ptr [bp-4] ; original control word
newcw equ word ptr [bp-2] ; new control word

falog public falog
falog proc near

    push ax ; save registers and
    push bp ; make stack frame
    mov bp,sp ; for local variables
    sub sp,4
    fldl2t ; load log2(10)

    fmulp st(1),st(0) ; log2(10) * argument
    fld st(0) ; duplicate product
    fstcw oldcw ; get old control word
    fwait ; wait till it arrives
    mov ax,oldcw ; change rounding mode
    and ax,0f3fffh ; field to "round down"
    or ax,0400h
    mov newcw,ax
    fldcw newcw ; force rounding mode
    frndint ; get int part of product
    fldcw oldcw ; restore old rounding mode
    fld st(0) ; duplicate integer part
    fxch st(2) ; get original product
    fsubrp st(1),st(0) ; find fractional part
    fldl fchs ; scale fractional part
    fxch st(1)
    fscale ; discard coprocessor junk
    fstp st(1) ; raise 2 to power-1
    f2xm1 ; correct for the -1
    faddp st(1),st(0) ; square result
    fmul st(0),st(0) ; scale by int part
    fstp st(1) ; discard coprocessor junk
    add sp,4 ; discard local variables
    pop bp ; restore registers and
    pop ax ; return result in ST(0)
    ret

falog endp

_TEXT ends

end

```



Figure 3: A simple example of a routine that finds the common antilog of a floating-point number.

er, simply to save and restore the rounding mode in a TSR, device driver, or interrupt handler. You may also need to save and restore the coprocessor "environment" or even the entire coprocessor state, including the contents of the floating-point register stack, to ensure that your calculations will be carried out successfully. This necessitates a lot of storage and processor cycles, and also requires attention to problems of reentry.

EXCEPTION HANDLING

The coprocessor recognizes six basic types of exceptions (errors) for floating-point operations:

- invalid operation
- divide by zero
- denormalized operand
- overflow
- underflow
- inexact result (precision)

When an exception occurs, the result depends on the state of the exception mask bits in the word in the coprocessor control register (See January 16, 1989, Power Programming, Figure 5). If the mask bit for the particular exception is clear (0), the coprocessor sets the appropriate error bits in the word in the coprocessor status register, and triggers an interrupt (See January 16,

1989, Power Programming, Figure 4). The interrupt number generated depends on the CPU model. On the 8086 or 8088, the interrupt is signaled via an 8259 programmable interrupt controller or the CPU's NMI line; on the 80286, 80386, and 80486 CPUs, an interrupt 10h is generated. Note that the interrupt does not occur when the error is detected by the coprocessor, but rather when the CPU next encounters an FWAIT or floating-point instruction. The interrupt handler can use FSTENV or FSAVE to unload the state of the coprocessor into RAM, deduce the cause of the error, and take the appropriate recovery measures.

If the mask bit for the particular exception in the word in the coprocessor control register is set (1), the coprocessor sets the error bit in the word in the status register and fixes up the result of the operation that caused the exception so that calculations can continue. Depending on the type of error, the coprocessor will return zero, infinity, indefinite, a denormalized value, or one of several special bit patterns known as "Not-a-Number" (NaN). The error bits in the word in the status register are "sticky." That is, they remain set through subsequent floating-point operations until they are cleared by execution of FCLEX,

FRSTOR, FLDENV, or by initialization of the coprocessor. The "fix-up result" may be propagated through subsequent floating-point operations or may "disappear," depending on its nature. For example, a very small denormalized value, if added to a large normalized value, essentially vanishes and is of no further concern in the calculation.

Aside from the interrupt 10h exceptions generated by the coprocessor directly, there are several other interrupts that may occur as a result of a coprocessor operation. The most basic of these is interrupt 7, which is generated when a floating-point instruction is executed but no coprocessor is present. The intent of interrupt 7 is to allow use of automatic traps to routines in an emulator library, so that the identical object code can run on systems that have or do not have coprocessors. In the case of the 80286, 80386, and 80486 processors running in protected mode, interrupt 09h (segment overrun), interrupt 0Bh (segment not present), interrupt 0Ch (stack fault), or interrupt 0Dh (general protection fault) may occur if an address used in a floating-point instruction lies partially or completely outside a valid segment. These protected mode interrupts are typically handled in an operating system rather than in an applica-

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CIRCLE 263 ON READER SERVICE CARD

Power Programming

FTRIG.ASM

1 of 2

```

title FTRIG.ASM 88x87 Sine, Cosine, Tangent
page 55,132

; FTRIG.ASM --- 88x87 Sine, Cosine, Tangent Functions
; Copyright (C) 1989 Ziff Davis Communications
; PC Magazine - Ray Duncan
;
; Procedure FSIN calculates sine(x)
; Procedure PCOS calculates cosine(x)
; Procedure PTAN calculates tangent(x)
;
; All three procedures have the same calling sequence:
; Call with: ST(0) = argument in radians
; Returns: ST(0) = result
; Uses: AX, BX. Other registers preserved.
;
; Make sure coprocessor has been properly initialized
; with a previous call to INIT87!

_DATA segment word public 'DATA'

pi2 dd 3ff921fb54442d18h ; constant pi / 2
pi4 dd 3fe921fb54442d18h ; constant pi / 4

plusinf dd 87f8888888h ; +infinity encoding
neginf dd 8ff8888888h ; -infinity encoding

oldcw dw 0 ; old control word
newcw dw 0 ; new control word

temp dw 0 ; scratch storage

cctab db 0,4,1,5,2,6,3,7 ; relates condition code
; bits to octant numbers

fsintab label word ; sine dispatch table
dw fsin0 ; octant 0
dw fsin1 ; octant 1
dw fsin2 ; octant 2
dw fsin3 ; octant 3
dw fsin4 ; octant 4
dw fsin5 ; octant 5
dw fsin6 ; octant 6
dw fsin7 ; octant 7

ftantab label word ; tangent dispatch table
; for reduced angle <> 0
dw ftan0 ; octant 0
dw ftan1 ; octant 1
dw ftan2 ; octant 2
dw ftan3 ; octant 3
dw ftan4 ; octant 4
dw ftan5 ; octant 5
dw ftan6 ; octant 6
dw ftan7 ; octant 7

ftanztab label word ; tangent dispatch table
; for reduced angle = 0
dw ftanz0 ; octant 0
dw ftanz1 ; octant 1
dw ftanz2 ; octant 2
dw ftanz3 ; octant 3
dw ftanz4 ; octant 4
dw ftanz5 ; octant 5
dw ftanz6 ; octant 6
dw ftanz7 ; octant 7

_DATA ends

_TEXT segment word public 'CODE'
assume cs:_TEXT,ds:_DATA

fsin public fsin
proc near ; calculate sine of ST(0)

call octant ; reduce angle, find octant
shl bx,1 ; form index to jump table
jmp [bx+fsintab] ; branch to correct sequence

fsin0: call psin ; octant 0
ret ; sin(x) = psin(x)
fsin1: fsubr pi2 ; octant 1
call pc ; sin(x) = pc((pi/4)-x)
ret
fsin2: call pcos ; octant 2
ret ; sin(x) = pcos(x)
fsin3: fsubr pi4 ; octant 3
call psin ; sin(x) = psin((pi/4)-x)
ret
fsin4: call psin ; octant 4
fchs ; sin(x) = -(psin(x))
ret
fsin5: fsubr pi4 ; octant 5
call pc ; sin(x) = -(pcos((pi/4)-x))
ret
fsin6: call pcos ; octant 6
fchs ; sin(x) = -(pcos(x))
ret
fsin7: fsubr pi4 ; octant 7
call psin ; sin(x) = -(psin((pi/4)-x))
ret
fsin endp

fcos public fcos
proc near ; calculate cosine of ST(0)

call octant ; reduce angle, find octant
add bx,2 ; add pi/2 (90 degrees) and
and bx,7 ; then use sine routines
shl bx,1 ; form index to jump table
jmp [bx+fsintab] ; branch to correct sequence
fcos endp

ftan public ftan
proc near ; calculate tangent of ST(0)

call octant ; reduce angle, find octant
shl bx,1 ; form index for jump table
; is reduced angle = 0?
fstw temp
fwait
mov ax,temp
sahf
je ftanz ; reduced angle = 0
jmp [bx+ftantab] ; reduced angle <> 0

ftan0: ; octant 0
ftan4: ; octant 4
; get Y/X
iptan
fdi ; st(1),st(0)
ret

ftan1: ; octant 1
ftan5: ; octant 5
; (pi/4) - angle
; get Y/X
; 1/(Y/X)
fsubr pi4
iptan
fdi ; st(1),st(0)
fldi
fdi ; st(1),st(0)
ret

ftan2: ; octant 2
ftan6: ; octant 6
; get Y/X
iptan
fdi ; st(1),st(0)
fldi
fdi ; st(1),st(0)
fchs
ret ; -(1/(Y/X))

ftan3: ; octant 3
ftan7: ; octant 7
; (pi/4) - angle
; get Y/X
; -(Y/X)
fsubr pi4
iptan
fdi ; st(1),st(0)
fchs
ret

ftanz: fstp ; reduced angle = 0
; discard angle and
; go load special value
jmp [bx+ftanztab]

ftanz0: fldz ; 0 degrees
ret ; load constant 0
ftanz1: fld1 ; 45 degrees
ret ; load constant 1
ftanz2: fld plusinf ; 90 degrees
ret ; load constant +infinity
ftanz3: fld1 ; 135 degrees
fchs ; load constant -1
ret
ftanz4: fldz ; 180 degrees
ret

```

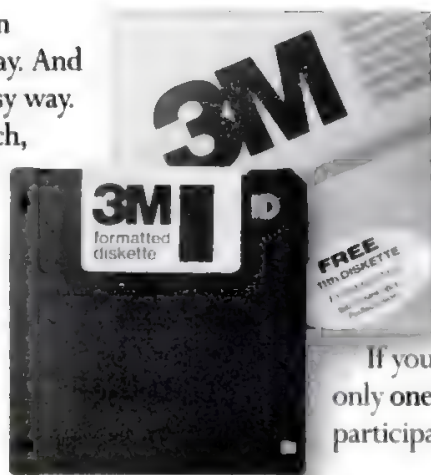
Figure 4: The source code for generalized tangent, sine, and cosine routines.

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Power Programming

FTRIG.ASM	2 of 2
<pre> ret ; load constant 0 ftanz5: fldl ; 225 degrees ret ; load constant 1 ftanz6: fld neginf ; 270 degrees ret ; load constant -infinity ftanz7: fldl ; 315 degrees fcha ret ; load constant -1 ftan endp ; PSIN: Partial sine ; Call with: ST(0) = angle in range 0 <= x < pi/4 ; Returns: ST(0) = sine ; psin proc near fptan ; get fraction Y/X fld ; sin = Y/sqrt(X*X+Y*Y) fmul st(1),st(0) fmul st(1),st(0) fmul st(1),st(0) faddp st(1),st(0) fsqrt fdivp st(1),st(0) ret ; leave divide running psin endp ; PCOS: Partial cosine ; Call with: ST(0) = angle in range 0 <= x < pi/4 ; Returns: ST(0) = cosine ; pcos proc near fptan ; get fraction Y/X fch ; cos = X/sqrt(X*X+Y*Y) fld st(1) fmul st(0),st(0) fmul st(1),st(0) fmul st(1),st(0) faddp st(1),st(0) fsqrt fdivp st(1),st(0) </pre>	<pre> ret ; leave divide running pcos endp ; ; OCTANT: Find octant occupied by angle. ; Call with: ST(0) = angle in radians ; Returns: ST(0) = reduced angle, 0 <= angle < pi/4 ; BX = octant(0-7) ; octant proc near push ax ; save register ftst ; test sign of angle fstsw temp ; unload FTST status fabs ; force angle positive push temp ; save FTST status fld pi4 ; load constant pi/4 fch st(1) ; put angle on top fprem ; reduce to 0<=angle<pi/4 fstsw temp ; unload FPREM status fwait ; wait till it arrives mov bx,temp ; retrieve status word and bx,4300h ; shift C3, C1, C0 status rol bx,1 ; bits (which contain rol bx,1 ; low 3 bits of quotient shl bh,1 ; from FPREM) to form shl bh,1 ; index in range 0-7, shl bh,1 ; then look up octant rol bx,1 rol bx,1 mov bl,[bx+cctab] ; now BX = actual octant pop ax ; get back FTST status sahf ; force CPU flags jae oct1 ; jump, orig. angle >= 0 fsubr st(0),st(1) ; angle was negative, sub bx,7 ; adjust reduced angle neg bx ; and octant oct1: fstp st(1) ; discard pi/4 constant pop ax ; restore register, return ; BX=octant, ST(0)=angle octant endp _TEXT ends end </pre>

ATOF.ASM	1 of 2
<pre> title ATOF - ASCII to Binary Floating Point page 55,132 ; ATOF.ASM --- Convert ASCII String to Binary ; Floating Point Number on 80x87 Stack ; (also requires FALOG from FALOG.ASM) ; ; Copyright (C) 1989 Ziff Davis Communications ; PC Magazine * Ray Duncan ; ; Call with: DS:SI = address of string in the form ; {sign}[digits][.][E e[sign][exp]] ; leading blanks or tabs are ignored ; ; Returns: ST(0) = binary floating point value ; DS:SI = address+1 of terminator ; ; Uses: Nothing ; ; This routine gives no warning in the event of ; overflow, and terminates on the first invalid character. ; ; Make sure coprocessor has been properly initialized ; with a previous call to INIT87! blank equ 20h ; ASCII blank character tab equ 09h ; ASCII tab character _DATA segment word public 'DATA' int10 dw 10 ; integer constant 10 digit dw 0 ; current converted digit places dw 0 ; number of decimal places _DATA ends _TEXT segment word public 'CODE' assume cs:_TEXT,ds:_DATA </pre>	<pre> extrn falog:near ; we need FALOG routine atof public proc near ; ASCII to floating point push ax ; save registers push si push dx call convert ; convert mantissa neg dx ; save -1 * decimal places mov places,dx or al,20h ; fold char to lower case cmp al,'e' je atof1 ; yes, jump fldz ; assume zero exponent jmp atof2 atof1: call convert ; convert exponent atof2: fiadd places ; adjust exponent for ; dec. places in mantissa call falog ; raise 10 to power fmul ; exponent * mantissa pop dx ; restore registers pop cx pop ax ret ; return ST(0) = result atof endp ; ; CONVERT: Called by ATOF to convert ASCII number ; with possible sign and/or decimal point </pre>



Figure 5: The source code for a routine that makes ASCII string-to-binary floating-point conversions.

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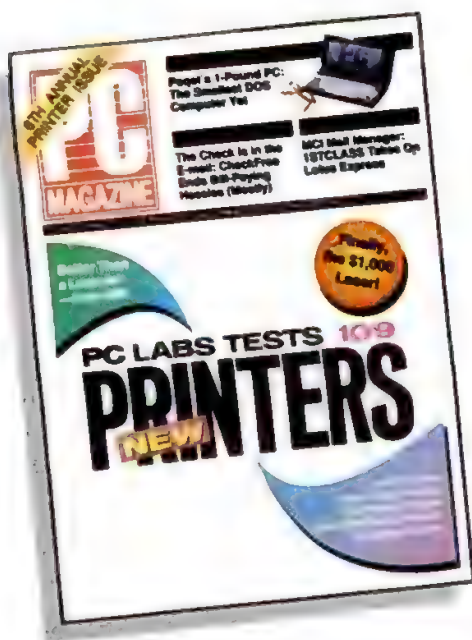
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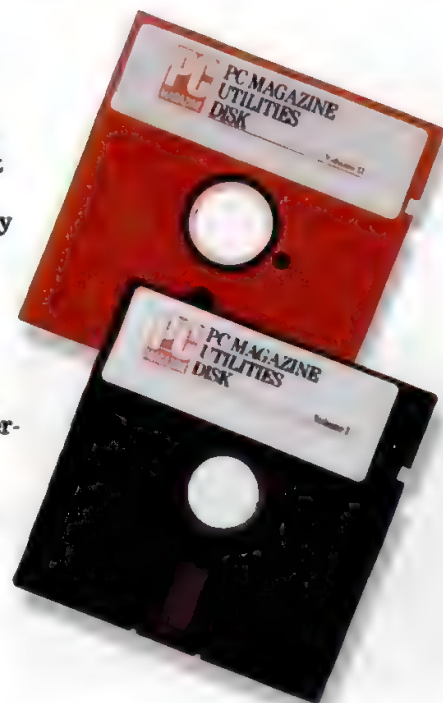


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```

; Call with: DS:SI = address of string
; Returns:  ST(8) = result
;           AL = first unconvertable character
;           DX = number of digits after decimal point
;           DS:SI = address+1 of character in AL
; Uses:     AH, CX

convert proc near ; convert numeric field
    fldz           ; initialize result
    xor     cx,cx   ; initialize sign
    mov     dx,-1   ; initialize decimal count

conv1: lodsb       ; scan off whitespace
    cmp     al,blank ; ignore leading blanks
    je      conv1
    cmp     al,tab    ; ignore leading tabs
    je      conv1

    cmp     al,'+'    ; if + sign proceed
    je      conv2
    cmp     al,'-'    ; is it - sign?
    jne     conv3
    dec     cx        ; no, test if numeric
                    ; yes, set flag

conv2: lodsb       ; get next character

conv3: cmp     al,'0' ; is character valid?
    jb      conv4
    cmp     al,'9'
                    ; jump if not '0' to '9'

ja      conv4      ; jump if not '0' to '9'

and     ax,0fh     ; isolate lower four bits
mov     digit,ax   ; and save digit value
fmul    int10      ; previous value * 10
fiadd   digit      ; accumulate new digit

or      dx,dx      ; past decimal point?
js      conv2      ; no, convert next digit
inc     dx         ; yes, count digits
jmp     conv2      ; convert next digit

conv4: cmp     al,'.' ; is it decimal point?
    jne     conv5    ; no, proceed
    inc     dx        ; indicate decimal found
    jmp     conv2     ; convert more digits

conv5: jcxz    conv6 ; jump if result pos.
    fchs         ; make result negative

conv6: or      dx,dx ; decimal point found?
    jns     conv7    ; yes, jump
    xor     dx,dx    ; no, return zero places

conv7: ret         ; return ST(8) = result

convert endp
_TEXT ends
end

```

tion. Finally, on the 80486, an interrupt 9 never occurs for a coprocessor instruction (an interrupt 0Dh is produced instead), and an interrupt 11h is optionally generated in the event of a coprocessor access to a non-aligned memory operand.

In general, the handling of coprocessor interrupts is a complicated business best left to systems programmers. Although detecting an exception interrupt is obviously quite simple, proper error recovery can be very difficult. In most application programs, I feel that it is generally better to mask all exceptions when the coprocessor is initialized and leave them masked, concentrating your energies on the algorithms and application design rather than on interrupt handlers. Your program can then check the word in the coprocessor status register at suitable intervals for an error flag and can test the results of all calculations for unexpected infinity, indefinite, or NaN values.

TRANSCENDENTAL FUNCTIONS

While the coprocessor family does support transcendental functions such as logs, sines, cosines, tangents, and their inverses, this support is not as complete and straightforward as might be wished. As shown in Figure 2, the transcendental functions are supplied in the form of rather primitive operations with limited ranges. They must be used as building blocks for more generalized procedures, and the derivation of the generalized routines is not in-

**The instructions
FYL2X, FYL2XP1,
FLDLG2, and FLDLN2
let the coprocessor
efficiently calculate
common and
natural logs.**

tuitively clear to anyone who has not recently completed college math courses. (Those courses lie deep in the dim past for me, I'm afraid).

Let's look first at logs and antilogs. The log to the base n of any number X, where X is greater than zero, can be found by

$$\log_n(2) * \log_2(X)$$

The instructions FYL2X ($Y * \log_2(X)$) and FYL2XP1 ($Y * \log_2(X+1)$), together with the load constant instructions FLDLG2 (load $\log_{10}(2)$) and FLDLN2 (load $\log_e(2)$) allow common (base 10) and natural (base e) logs to be calculated very efficiently. For instance, to obtain the common log of a number, after having screened the num-

ber to make sure it is valid and positive, you could write

```

myvar dd 8
.
.
fldlg2
fld myvar
fyl2x
fstp myvar
fwait

```

The FYL2XP1 instruction is used in a similar sequence for a more precise result when the argument is very close to 1.

Finding antilogs is much more tedious. The general approach for finding the antilog to the base n of some number X is

$$n^X = 2^X * \log_2(n)$$

So, to find common and natural antilogs, we need the instructions FLD1 (load constant one), FLDL2E (load $\log_2(e)$), FLDL2T (load $\log_2(10)$), F2XM1 ($2^X - 1$)), and FSCALE ($X * 2^Y$). FSCALE raises 2 to a power, but integer powers of 10 (or e) don't correspond to integer powers of 2. Thus, we decompose the argument integer and fractional portions with FRNDINT and FSUB and then exploit the relationship

$$2^{(Y+Z)} = 2^Y * 2^Z$$

Figure 3 contains a somewhat simplified


```

title      FTOA - floating point to ASCII
page       55,132

; FTOA.ASM --- Convert Binary Floating Point
;               Number on 80x87 Stack to ASCII
;               (also requires FALOG from FALOG.ASM)
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; PC Magazine * Ray Duncan

; Call with:    ST(0) = floating point number
;               DS:SI = buffer to receive string
; Returns:      DS:SI = address of converted string
;               AX    = length of string
;               Coprocessor stack "popped"
; Uses:         Nothing
; Make sure coprocessor has been properly initialized
; with a previous call to INIT87!

_DATA      segment word public 'DATA'

sign       dw      0          ; receives FXAM status
oldcw      dw      0          ; previous rounding mode
newcw      dw      0          ; new rounding mode
exp        dw      0          ; extracted power of ten
status     dw      0          ; receives FCOM status
mant       dt      0          ; mantissa as BCD value

fp1e17     dq      1.0e17     ; constant for scaling
fp1e18     dq      1.0e18     ; constant for scaling
int10      dw      10         ; constant for scaling

pzstr      db      '+0.0000000000000000E+000' ; displayed if
pz_len     equ     $-pzstr    ; ST(0) = +0

nzstr      db      '-0.0000000000000000E+000' ; displayed if
nz_len     equ     $-nzstr    ; ST(0) = -0

pistr      db      '<+infinity>' ; displayed if ST(0)
pi_len     equ     $-pistr    ; is positive infinity

mistr      db      '<-infinity>' ; displayed if ST(0)
mi_len     equ     $-mistr    ; is negative infinity

nanstr     db      '<NaN>' ; displayed if ST(0)
nan_len    equ     $-nanstr   ; contains Not-A-Number

unstr      db      '<unnorm>' ; displayed for positive
un_len     equ     $-unstr    ; or negative unnormals

destr      db      '<denorm>' ; displayed for positive
de_len     equ     $-destr    ; or negative denormals

empstr     db      '<empty>' ; displayed if ST(0)
emp_len    equ     $-empstr   ; is tagged "empty"

; number types from
; condition code bits
typetab    dw      ftoa14     ; 0000 +unnorm
dw      ftoa15     ; 0001 +NaN
dw      ftoa14     ; 0010 -unnorm
dw      ftoa15     ; 0011 -NaN
dw      ftoa1     ; 0100 +normal
dw      ftoa16     ; 0101 +infinity
dw      ftoa1     ; 0110 -normal
dw      ftoa17     ; 0111 -infinity
dw      ftoa10     ; 1000 +zero
dw      ftoa12     ; 1001 empty
dw      ftoa11     ; 1010 -zero
dw      ftoa12     ; 1011 empty
dw      ftoa13     ; 1100 +denormal
dw      ftoa12     ; 1101 empty
dw      ftoa13     ; 1110 -denormal
dw      ftoa12     ; 1111 empty

_DATA      ends

_TEXT      segment word public 'CODE'

assume     cs:_TEXT,ds:_DATA

extern     falog:near ; we need FALOG routine

ftoa       public ftoa
proc       near ; floating point to ASCII

push       bx ; save registers
push       cx
push       dx
push       di
push       es

push       ds ; let DS point to _DATA
pop        es

; test type of number
; unload FXAM status
sign       sign
; retrieve status and
; shift C3, C2, C1, C0
; status bits to form
; value 0-15, then
; *2 for jump index
fxam
fstsw      sign
fwait
mov        bx,sign
and        bx,4700h
rol        bx,1
rol        bx,1
shl        bh,1
shl        bh,1
shl        bh,1
rol        bx,1
rol        bx,1
rol        bx,1
shl        bx,1
jmp        [typetab+bx] ; branch by number type

ftoa1:     fwait ; force number positive
; extract exponent
; put exponent on top
; form power of 10
fextract
fexch      st(1)
fldlg2
fmulp      st(1),st(0)
oldcw      oldcw ; save current rounding mode
fwait
mov        ax,oldcw ; set bit field for rounding
or         ax,0c00h ; mode to "chop"
mov        newcw,ax
fldcw      newcw ; force new rounding mode
fld        st(0) ; duplicate power of ten
frndint    exp ; find integer part of
; exponent and save it
; restore old rounding mode
; find fractional part of
; power of ten
; then times mantissa
; scale mantissa for BCD
; zap any remaining fraction
fist       exp
fldcw      oldcw
fsubp      st(1),st(0)
call       falog
fmulp      st(1),st(0)
fmulp      fp1e18
frndint

ftoa2:     fcom      fp1e17 ; is mantissa < 1.0e17?
fstsw      status
fwait
mov        ax,status
sahf
jae        ftoa3 ; no, proceed
; yes, mantissa * 10
; and decrement exponent
fimul      int10
dec        exp
jmp        ftoa2

ftoa3:     fcom      fp1e18 ; is mantissa < 1.0e18?
fstsw      status
fwait
mov        ax,status
sahf
jb         ftoa4 ; yes, proceed
; yes, mantissa / 10
; and increment exponent
fidiv      int10
inc        exp
jmp        ftoa3

ftoa4:     fbstp     mant ; unload mantissa in BCD
fwait
mov        di,si ; address for ASCII string
mov        al, '+' ; assume positive
test       sign,200h ; check FXAM flags
js         ftoa5 ; jump, value was positive
mov        al, '-'

ftoa5:     stosb     al, '0' ; store + or - sign
; store leading zero
stosb
stosb
stosb
stosb
mov        bx,8 ; point to last BCD digits

ftoa6:     mov       al,byte ptr [bx+mant] ; convert BCD byte to
shr        al,1 ; two ASCII digits
shr        al,1
shr        al,1
shr        al,1
call       digit ; convert high nibble
mov        al,byte ptr [bx+mant] ; convert low nibble
call       digit ; back up through BCD value
dec        bx ; until 10 digits converted
jns        ftoa6

mov        al, 'E' ; store 'E' for exponent
stosb
mov        bx,exp ; test sign of exponent
mov        al, '+'
or         bx,bx
jns        ftoa7 ; jump, exponent positive
mov        al, '-' ; abs. value of exponent
neg        bx

ftoa7:     stosb     ; store sign of exponent
mov        ax,bx ; convert exponent to
cwb        ; three ASCII digits

```

Figure 6: The complement to Figure 5, FTOA.ASM is the source code for a binary floating-point-to-ASCII-string conversion routine.

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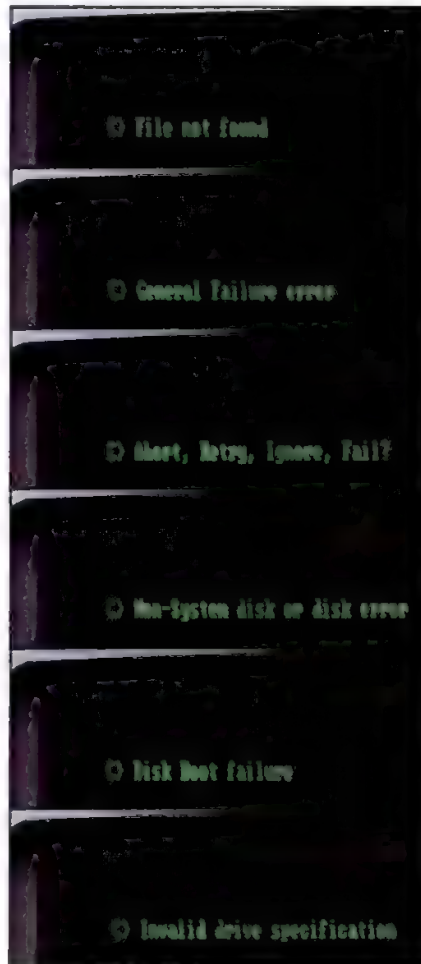
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Peter Norton
COMPUTING

Power Programming

FTOA.ASM

2 of 2

```

mov     cx,100
div     cx
call    digit                ; exponent hundreds digit
mov     ax,dx
cld
mov     cx,10
div     cx
call    digit                ; exponent tens digit
mov     ax,dx
call    digit                ; exponent ones digit

ftoa8:  mov     ax,di          ; return AX = string length
sub     ax,si                ; and DS:SI = string address

pop     es                   ; restore registers
pop     di
pop     dx
pop     cx
pop     bx
ret

ftoa10: mov     di,offset p2str ; +zero value
mov     cx,p2_len
jmp     ftoa20

ftoa11: mov     di,offset m2str ; -zero value
mov     cx,m2_len
jmp     ftoa20

ftoa12: mov     di,offset empstr ; empty value
mov     cx,emp_len
jmp     ftoa20

ftoa13: mov     di,offset destr ; denormal value
mov     cx,de_len
jmp     ftoa20

ftoa14: mov     di,offset unstr  ; unnormal value
mov     cx,un_len
jmp     ftoa20

ftoa15: mov     di,offset nanstr ; NaN value

mov     cx,nan_len
jmp     ftoa20

ftoa16: mov     di,offset pistr  ; +infinity value
mov     cx,pi_len
jmp     ftoa20

ftoa17: mov     di,offset mistr  ; -infinity value
mov     cx,mi_len

ftoa20: xchg     si,di          ; SI = canned string
push    di                  ; DI = caller's buffer
rep     movsb               ; copy canned string
pop     si                  ; restore SI
fstp    st(0)               ; discard original value
jmp     ftoa8               ; go to common exit point

ftoa    endp

; DIGIT: Convert low nibble of AL to ASCII digit
; and store at address given by DS:DI
; Call with: AL = value to be converted in bits 0-3
; ES:DI = address to store ASCII character
; Returns: AL = unchanged
;          ES:DI = address+1

digit   proc    near                ; nibble to ASCII digit

push    ax                    ; save register
and     al,8fh                ; isolate nibble
add     al,'0'                 ; convert to ASCII char
stosb   ; store the character
pop     ax                    ; restore register

digit   endp

_TEXT   ends

end

```

example of the code for finding the common antilog of a number. In production code, you would also want to add logic to check for invalid arguments. Note how the code in Figure 3 temporarily forces the rounding mode for the duration of the FRNDINT instruction, ensuring that the fractional portion of the number will lie within an acceptable range for F2XM1.

While you might think this antilog code messy, it is trivial compared with the contortions you must go through to find sines, cosines, and tangents of arbitrary angles. The coprocessor support for all these functions consists of a partial tangent instruction (FPTAN) that can cope only with arguments in the range from 0 to $\pi/4$ radians (0 to 45 degrees). Therefore, the angle must first be reduced into this range with the FPREM instruction. The standard trigonometric identities are then exploited to obtain the desired result. Figure 4 contains simplified source code for generalized tangent, sine, and cosine functions. Again, in production code you would want to add much more extensive argument checking.

Fortunately, calculating the inverse trigonometric functions is much less painful. The partial arctangent instruction (FPATAN) requires only that both its ar-

**Trigonometric
functions are easily
calculated on the
80387 or 80486.**

guments be nonnegative and that the argument on top of the stack be larger than the one next to it on the stack. Thus, obtaining a generalized arctangent simply requires you to load the angle and the constant one and execute a possible swap before executing FPATAN. Arcsine and arccosine can be easily derived from the generalized arctangent using standard trigonometric relationships. The hyperbolic functions and their inverses are also readily obtained with the aid of natural logs, antilogs, and the square root instruction.

When an 80387 or 80486 is available, most of these trigonometric shenanigans are not needed at all. The two latter-day numeric coprocessors support generalized forms of FPTAN and FPATAN that can accept any angle without prior reduction.

They also provide generalized FSIN, FCOS, and FSINCOS instructions that obviate the use of the complicated procedures shown in Figure 4. For example, to take the sine of a number:

```

.387
.
.
myvar dd 0
.
.
fld    myvar
fsin
fstp   myvar
fwait

```

INPUT AND OUTPUT

Your most untidy task when using the numeric coprocessors is input and output: converting ASCII strings into floating-point numbers and vice versa. The primary problem here is the fact that floating-point numbers are expressed as fractions in base 2 times a power of 2 for the convenience of the computer, but these numbers do not convert neatly into human-friendly fractions of 10 times a power of 10. Writing robust, efficient conversion routines requires more extensive use of the coproces-

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Power Programming

sor's capabilities and instruction set than anything we have yet discussed.

Figure 5 contains the source code for the procedure ATOF, which converts an ASCII string into a 64-bit floating-point number. ATOF converts the mantissa and the exponent into binary numbers separately, updates the exponent by the number of digits found after the decimal point in the mantissa, raises 10 to the power of the exponent, then multiplies that result by the mantissa. The arguments, results, and a detailed explanation of the method, are contained in the source code.

The two latest
coprocessors let you
calculate SIN
and COS directly.

The source code for the inverse procedure, FTOA is listed in Figure 6. The overall approach is to use the FXTRACT instruction to pick apart the mantissa and the binary exponent, convert the binary exponent to a power of 10, scale the mantissa (while adjusting the exponent) until it is an integer, and then bring the integer out of the coprocessor as an 18-digit BCD value that can be transformed directly into ASCII characters. Again, the parameters and results for the procedure, as well as additional comments about the method used, can be found in the listing.

ATOF and FTOA should be regarded only as simple models of conversion routines, for they trade away some accuracy and speed in favor of simplicity. Once you understand how ATOF and FTOA work, you may want to refer to the Intel coprocessor manuals for examples of more complex, precise conversion routines.

THE IN-BOX

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Date of Residence:		Month		Year		Monthly Payment: \$		Buy		Rent	Other
Previous Address:		Street		Apt. #	City	State	Zip	Date of Residence:		From	To
Your Employer: (If self-employed, see rear panel)		Date of Employment:		Mo		Yr	Position:	Monthly Income:		Gross \$	Net \$
Employer's Address:		Street		Apt. #	City	State	Zip	Business Phone		() -	
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Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as a basis for repaying this obligation.		Other Income		I have received since (Date)		Monthly Income		Gross \$	Net \$		
Name and Address of Nearest Relative Not Living With You										Relationship	

b. Credit Information										Include joint applicant's information if joint account requested	
Bank Account:		Bank Name		Address		City		State	Zip	☐ Checking ☐ Savings	
Bank Account:		Bank Name		Address		City		State	Zip	Checking Savings	
Bank Loan Reference:		Bank Name		Address		City		State	Zip	Payment	Balance
Bank Card Reference:		Bank Name		Address		City		State	Zip		
Other Credit Card Reference:		Bank Name		Address		City		State	Zip		
Other Credit References:		Account No.		Expires		City		State	Zip		
Driver's License No.		State		Expires		City		State	Zip		

c. Joint Applicant's Personal Information										* If you are a married Wisconsin applicant, you must provide your spouse's information below even though your spouse may not be signing this contract.	
Joint Applicant's Name:		First	Initial	Last	Date of Birth:		Mo		Day	Yr	Social Security Number
Address:		Street		Apt. #	City	State	Zip	Date of Residence:		Mo	Yr
Employer:		Date of Employment:		Mo		Yr	Position:	Monthly Income:		Gross \$	Net \$
Employer's Address:		Street		Apt. #	City	State	Zip	Business Phone:		() -	

d. Self-Employed Information										Complete this section only if you are self-employed	
Business Name:		Proprietorship		Corporation		Partnership		Business Address:		Business Telephone () -	
Description of Business:		Your Position:		In Business Since:		Business annual income (gross)		Business annual income (net)			
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by
Neil J. Rubenking

User-to-User

QUICK-FORMAT YOUR DISKS

I had a few dozen used disks that I wanted to reinitialize, but reformatting all of them would take too long. A simple `DEL A:*` would do the job, but even this has delays. First you have to answer the Y/N prompt, and then, if there are subdirectories on the disk . . . Need I say more?

My solution is to run DEBUG, place a freshly formatted disk in drive A:, and at the DEBUG prompt enter

```
L 100 0 0 C
```

This command tells DEBUG to LOAD to memory at relative address 100h from disk 0 (0=A:, 1=B:, 2=C:, and so on) starting with sector 0 and load 0Ch (12 decimal) sectors.

Next, put a used disk into drive A: and enter

```
W 100 0 0 C
```

This command writes the twelve sectors onto the disk in drive A:. At this point, all you need to do is to replace disks in drive A:, press the F3 key to copy the command line, and then hit Enter. When all your disks have been reinitialized, enter Q to exit from DEBUG.

Note that this procedure works for 360K disks only. Use `L 100 0 0 E` (14 sectors) for 720K disks and `L 100 0 0 1D` (29 sectors) for 1.2M disks. Your disks must all have been formatted before, and they must all be the same size. Even with changing disks, this method takes only seconds per disk.

George Yarmoluk
Richmond, British Columbia
Canada



Formatting a floppy disk writes over all of its data space and sets up a blank FAT and root directory. If you don't mind leaving the old data bytes on the rest of the disk, you can get the same effect by setting up *only* a blank FAT and root directory. As far as DOS knows, the disk is blank. All sectors in the file area are

■ **QUICK-FORMAT YOUR DISKS:** Here's a really fast way to reformat disks by reinitializing only the FAT and the root directory.

■ **TESTING FOR ANSI.SYS:** Your batch files can test for the presence of ANSI.SYS before they attempt to use it.

■ **CLEAR YOUR SCREEN IN COLOR:** Patch `COMMAND.COM` to clear the screen in color, even when you don't know the exact patch location.

available to be overwritten.

Copying 12 sectors initializes a 360K disk, but other sizes need different numbers. You don't have to depend on a list of sizes—DEBUG can examine a disk and calculate the size for you.

`BPB.SCR` (Figure 1) is a DEBUG script that calculates the size of the FAT and the root directory, and the total num-

ber of sectors needed to quick-format a disk. It uses information from the BIOS Parameter Block (BPB), which is part of the boot sector, the very first sector on the disk. The BPB stores the number of copies of the FAT, the number of sectors required by each, the number of bytes in a sector, and the number of 32-byte entries in the root directory. Using these four numbers, you can calculate the number of sectors required.

The DEBUG script first loads the BPB information at offset 200 with the command `L 200 0 0 1`. If you're checking drive B:, change this to `L 200 1 0 1`. Next the script assembles instructions in memory that carry out the calculations described in the previous paragraph. Finally it runs these instructions and displays the final contents of all the registers. The next three lines just tell you how to interpret the results—DEBUG rejects them as errors.

To use the script, put a disk in drive A: and give the command

```
DEBUG < BPB.SCR | FIND "X="
```

Of course DEBUG and FIND must be available on your PATH. The FIND filter removes all lines that don't contain "X=", so all you see is the result.

BPB.SCR	COMPLETE LISTING
<pre>L 200 0 0 1 A 100 XOR AX,AX MOV AL,[210] ;number of FATs MOV BX,[216] ;size of FATs MUL BX MOV BX,AX ;total size of FATs now in BX MOV AX,[20B] ;bytes per sector MOV CL,20 DIV CL MOV CL,AL ;# of directory entries per sector now in CL MOV AX,[211] ;number of root dir entries. DIV CL ;total size of root directory now in AX MOV CX,AX ADD CX,BX INC CX G120 AX= number of sectors used by Root directory BX= number of sectors used by FATs CX= number of sectors to copy for quick-format Q</pre>	

Figure 1: This DEBUG script calculates the size of the FATs and root directory for the disk in drive A:.

User-to-User

TESTING FOR ANSI.SYS

Since many of the programs that I use regularly utilize ANSI sequences to change the display or modify screen colors, I wrote the program ANSIHERE.COM. The program checks to see if ANSI.SYS is loaded, issues an appropriate status report if it is desired, and sets the ERRORLEVEL accordingly.

The assembler listing for ANSIHERE.COM is shown in Figure 2. As you can see from the source code, the program uses one of the techniques proposed by Charles Petzold in PC Tutor (PC Magazine, September 15, 1987). Specifically, the program writes the ANSI Device Status Report (DSR) sequence to the display and then checks the keyboard buffer for input. If ANSI.SYS is loaded, it will send a Cursor Position Report (CPR) via the standard input (the keyboard). At this point if there is anything in the keyboard buffer, we can assume that it's a CPR and that ANSI.SYS is loaded.

The syntax is

ANSIHERE [S]

The ANSIHERE program sets the ERROR-

LEVEL and displays an "ANSI is [not] loaded" status message. There is an optional S parameter that will suppress output of the

It's easy to find the correct sequence of bytes to patch COMMAND.COM using DEBUG. But make sure you have a bootable disk with a copy of COMMAND.COM in case you enter data at the wrong address.

status message.

The ERRORLEVEL is set to 1 if ANSI is loaded and to 0 if it's not, so ANSIHERE S can be used for ERRORLEVEL tests in batch files. NEEDANSI.BAT, shown in Fig-

ure 3, shows users how to use ANSIHERE to control the execution of programs that require ANSI.

William Loud
Emmett, Idaho



A really brilliant ANSIHERE.COM would parse the keyboard input it finds and look for a valid cursor position report. You can fool ANSIHERE by pressing and holding down a key immediately after you run it. Try it, either with ANSIHERE itself or NEEDANSI.BAT. But the likelihood of someone fooling ANSIHERE like that is not great enough to make rewriting the program worthwhile.

DEBUG is everywhere—MASM is not. So I wrote a little DEBUG script (Figure 4) that creates a simplified version of ANSIHERE.COM. Type in each line exactly, omitting the comments if you wish. Be sure to include the two blank lines. Then give the command

DEBUG < ANSI.X.SCR

to create ANSI.X.COM. ANSI.X doesn't display any messages; it just sets ERRORLEVEL to 1 if ANSI is loaded, 0 if not. You can substitute ANSI.X for ANSIHERE with the S parameter set in NEEDANSI.BAT.

ANSIHERE.ASM		COMPLETE LISTING	
<pre>; ANSIHERE.ASM - Check to see if ANSI.SYS is loaded and display message. ; Exit with errorlevel = 1 if ANSI is loaded, 0 otherwise ; by William Loud ; (c) 1990 Ziff Communications Co. ; ; SYNTAX: ANSIHERE [S] ; The 'S' parameter will suppress output of the status ; message when ANSIHERE is used in batch files. ; ; This program checks for ANSI by writing the ANSI Device Status Report ; (DSR) sequence to the display. If ANSI is loaded, it will output a ; Cursor Position Report (CPR) to the standard input device (the keyboard). ; Therefore, if you issue a DSR and find anything in the keyboard buffer, ; you can assume it's a CPR and that ANSI is loaded. Conversely, if the ; keyboard buffer is empty, then ANSI is not loaded. TITLE ANSIHERE CODE_SEG SEGMENT ;Define code segment ASSUME CS:CODE_SEG,DS:CODE_SEG ORG 100h start: jmp begin ;skip over data ;----- ; Identity: 1b ' ' ANSIHERE.COM ',26 ; (Print msg) 0b ' ' ;exit code, default is no ANSI ; DSR string: 0b ' ' ;Device Status Report ANSI string ; YesMsg: 0b ' ' ;'ANSI.SYS is loaded.' ; NoMsg: 0b ' ' ;'ANSI.SYS is NOT loaded.' ; EraseDSR 0b ' ' ;13,13,12,12,12,'S' ; The message returned at the beginning of EraseDSR returns the cursor ; to the start of the current line and the four spaces will overwrite ; the garbage left by the DSR_string if ANSI is not loaded. begin: mov dx,OFFSET DSR_string ;display the ANSI DSR string call Print_String ;to see if ANSI is loaded mov ah,09h ;check for key in the keyboard int 21h ;buffer - if there's anything jnz al,0FFh ;there, ANSI is loaded clear_key ;go empty the buffer ; keyboard buffer is empty so ANSI is not loaded.</pre>		<pre>mov dx,OFFSET EraseDSR ;erase the garbage left by the call Print_String ; DSR String mov dx,OFFSET NoMsg ;point to 'not loaded' message jmp parse ;and check command line arguments ; ANSI is loaded. We must empty the keyboard buffer because it contains ; a Cursor Position Report which DOS will attempt to execute when this ; program terminates. clear_key: mov ah,06h ;get key from the keyboard buffer mov di,0FFh ;don't wait if the buffer is empty int 21h ;and don't print it to the screen jnz clear_key ;go back for more until buffer is ; empty and zero flag is set mov dx,OFFSET YesMsg ;point to 'ANSI is loaded' message mov Errorlevel,1 ;set errorlevel = 1 ; Check for command line arguments. If 'S' was entered on the command line ; we won't display the status message. When ANSIHERE is used in batch files ; we want to suppress the status message and use errorlevel tests to ; control program flow. parse: mov bx,0000h ;point to command line in EBP ; parse loop: cmp byte ptr [bx],13 ;is it a carriage return? je done ;done - print status message and byte ptr [bx],0Fh ;convert to uppercase cmp byte ptr [bx],'S' ;is it 'S'? jne parse_loop ;no - get another character yes ;yes - skip status message exit ;----- ; Print msg: call Print_String ;print status message ; exit: mov ah,4Ch ;DOS exit function in ah ; rcv al,Errorlevel ;errorlevel in a ; int 21h ;----- Print_String subroutine ----- Print_String: mov ah,09h ;print string function int 21h ret CODE_SEG ENDS END start</pre>	

Figure 2: This is the source code listing for ANSIHERE.COM. This program tests for the presence of ANSI.SYS and reports its result either on the screen or in the ERRORLEVEL.

User-to-User

NEEDANSI.BAT

COMPLETE LISTING



```

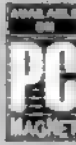
ECHO OFF
ANSIHERE S
IF ERRORLEVEL 1 GOTO GotANSI
REM ANSI is not loaded
ECHO This program requires the DOS
ECHO device driver ANSI.SYS. To
ECHO install ANSI, place the following line
ECHO     DEVICE={d:}[path]ANSI.SYS
ECHO in your CONFIG.SYS file and reboot.
GOTO END
:GotANSI
ECHO ANSI.SYS is loaded so the
ECHO commands to execute your
ECHO program would go here.
:END

```

Figure 3: This batch file demonstrates how to use ANSIHERE.COM in a batch file.

ANSIX.SCR

COMPLETE LISTING



```

N    ANSIX.COM
A100
JMP  010D          ;skip over data

E 102 1B'[6n$'
E 107 0D 20 20 20 20 'S'
A10D
MOV  DX,102        ;display the ANSI DSR string
MOV  AH,09         ;to see if ANSI is loaded
INT  21
MOV  AH,0B         ;check for key in the keyboard
INT  21            ;buffer -- if there's anything
CMP  AL,FF         ;there, ANSI is loaded
JZ   0128          ;go empty the buffer
MOV  DX,107        ;erase the garbage left by the
MOV  AH,09         ;DSR string
INT  21
MOV  AX,4C00       ;exit w/ errorlevel 0
INT  21
MOV  AH,6         ;get key from keyboard buffer
MOV  DL,FF        ;don't wait if buffer is empty
INT  21           ;and don't print it to the screen.
JNZ  128          ;go back for more 'til buffer is empty
MOV  AX,4C01       ;exit w/ errorlevel 1
INT  21

RCX
35
W
Q

```

Figure 4: This DEBUG script creates ANSIX.COM, a utility that performs the same function as ANSIHERE with the S option set.

CLEAR YOUR SCREEN IN COLOR

For quite some time I've been trying to get DOS to use a color other than white on black without using ANSI.SYS. A suggestion in User-to-User (*PC Magazine*, March 28, 1989) seemed to be just what I was looking for.

I loaded COMMAND.COM into DEBUG in order to modify the byte that sets the screen color and, just to make sure that I was about to change the correct byte, I entered E 2BAD to examine the value at that location. Pronouncing 2BAD turned out to be quite prophetic—DEBUG indicated that I was about to change a byte with the value of B4h, not 07h. Obviously, I had the wrong offset.

With the help of User-to-User in the December 10, 1985, issue of *PC Magazine* and an old version of COMMAND.COM, I determined that the CLS command in DOS 3.1 consisted of the following sequence of values:

```

B4 0B 33 DB CD 10 B4 0F CD 10 8A
D4 FE CA B6 19 33 C8 8B C8 BB
00 07 B4 06 CD 10 33 D2 B7 00
B4 02 CD 10

```

I then used the Find command in the *PC Shell* utility of *PC Tools Deluxe*, Version 5.0, to examine my DOS 3.30 COMMAND.COM file. I discovered that the CLS command began at offset 2BB2h, while the col-

or attribute byte was at offset 2BC8h, not 2BADh.

I'm not sure why the byte containing the value 07h wasn't where I expected to find it. But by using the above procedure, I should be able to find the byte in question, no matter what version of DOS I may use—unless, of course, Microsoft radically changes the command sequence for CLS.

Rand Flory
Cody, Wyoming

 Here's an enterprising reader! When the description didn't fit his particular system, he simply tracked down the correct byte. He needn't have used *PC Tools*, though; DEBUG itself would have done the job. Here's how you can find the above sequence of bytes in an unknown version of COMMAND.COM.

First of all, make sure you have a bootable floppy disk with a copy of COMMAND.COM, in case you make an error. Use the command DEBUG COMMAND.COM to load the file. Check the file's size by entering RCX and pressing Enter twice. You'll get a hexadecimal number—mine is 62DB. Now perform the search. Build the search command as follows. Start with S CS:100 L and append the number from the RCX command. Skip a space and add the first 5 or 6 bytes from the list above. Then hit Enter. Probably, the result will be a single address—mine is 327A:2B97. If you get more than one address, try the search again using more bytes from the list.

Display the bytes at that address with the command D ####:####, where ####:#### is the address you got from the search. The bytes should match the list above. Find the 07 byte—that's the one you want to change. The address of the first byte in each line appears at the start of the line. To get the address of the 07 byte, just count across until you reach it, remembering to count in hex (9, A, B, C, not 9, 10, 11, 12).

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by
Jeff Prosis

Tutor

HOW MATH COPROCESSORS WORK

When does a math coprocessor work? Does the mere presence of one speed programs up, or will it only help those applications that do something special to make use of it? And if the latter is the case, how can a program tell if there's a math coprocessor installed?

Al Pape
Seguin, Texas



Math coprocessors, also known as numeric data processors or NDPs, don't do anything by themselves. They work only when programs specifically put them to work. It's hard to estimate exactly what percentage of programs are geared to make use of coprocessors, but there are certain classes of programs that traditionally rely rather heavily on them: CAD programs, for one, and spreadsheets for another. NDPs are particularly adept at dealing with complex data types and performing complex mathematical operations such as extracting square roots and calculating trigonometric values. Therefore, more-conventional products such as word processors and communications programs, which typically have need for only simple arithmetic integer operations, have little use for them.

What does it take to put a coprocessor to work? Intel CPUs understand instructions like MOV, CMP, and ADD. Intel math coprocessors—the 8087, the 80287, the 80387, and the 80387 work-alike built into the 486—extend the CPU instruction set with instructions like FLD, FADD, and FCOMP. NDP instructions, designed to manipulate real and integer data types with a high degree of precision, are preceded by an escape code that tells the CPU the following instruction is to be farmed out to the NDP. As a result, a program can issue instructions from either instruction set without regard to what will actually process them. CPU instructions will be executed by the CPU, while NDP instructions will be executed by the coprocessor.

■ **HOW MATH COPROCESSORS WORK:** These specialized chips don't do anything by themselves, yet some types of programs can't do without them.

■ **VGA BORDER SUPPORT:** How to control borders on the VGA.

Figure 1 shows the code listing for a short assembly language subroutine that uses conventional 80x86 instructions to add two 16-bit quantities stored in word-size memory locations. After a word is fetched into AX, the ADD instruction is used to add to it the contents of a second word, and the result is stored in a third memory location called SUM. This subroutine will execute exactly the same on any system, regardless of whether or not a coprocessor is installed, and will execute entirely within the CPU.

Figure 2 shows the equivalent routine written for an 80x87. The first instruction, FILD, pushes the 16-bit integer quantity in the referenced memory location onto the math coprocessor's internal register stack. FIADD adds to it the integer in another memory location. The final instruction, FISTP, pops the result off the stack and

copies it to SUM. The result is the same as is obtained with the code in Figure 1.

This simple example isn't at all representative of how much a math chip can speed things up. In fact, if you count clock cycles, you'll find that the code shown here actually takes longer to execute on an 80x87 than on an 80x86 because the latter does a pretty good job of adding and subtracting 16-bit integer quantities, both signed and unsigned. But when it comes to dealing with other types of data and performing more processor-intensive operations, the math coprocessor is the hands-down winner in terms of both execution time and ease of implementation.

Utilizing a coprocessor is an overt action. There is nothing either automatic or accidental about shifting a portion of the processing burden from the CPU to the NDP. Internally, the architecture of the 80x87 is quite different from that of the 80x86. Numbers are processed in an array of eight 80-bit registers known as the register stack. Quantities are pushed onto the stack and popped back off in traditional LIFO style. Individual registers can be addressed by the names ST(0) (or simply ST), ST(1), ST(2), and so on.

All operations are carried out with 80-bit precision internally, although external quantities are rarely more than 64 bits in length. When you transfer a 64-bit real number (the largest real number the coprocessor can handle, with a 52-bit significand, an 11-bit exponent, and 1 bit for the sign) to the register stack, the 80x87 con-

ADDING TWO 16-BIT INTEGERS ON AN 80x86

```
add86  proc far
        mov  ax,word ptr [int1]      ;Get first word
        add  ax,word ptr [int2]      ;Add second word
        mov  word ptr [sum],ax       ;Store result in memory
        ret
add86  endp
```

Figure 1: Intel microprocessors have simple arithmetic instructions built in to handle the addition, subtraction, multiplication, and division of 16-bit signed and unsigned integers. The code shown here adds two word-size integers.

Tutor

ADDING TWO 16-BIT INTEGERS ON AN 80X87

```
add87    proc far
        fild    word ptr [int1]
        fiadd   word ptr [int2]
        fistp   word ptr [sum]
        ret
add87    endp
```

Figure 2: Intel math coprocessors can perform complex operations on integer, floating-point, and packed decimal data types. Here, the coprocessor is used to add two 16-bit integers.

verts it to 80 bits before pushing it onto the stack, and back to 64 when it's popped off. Having the extra precision minimizes cumulative round-off error.

The code shown in Figure 2 is indicative of how a typical 80x87 operation is carried out. Before the two 16-bit integers can be added, at least one of them must be placed on the stack. Immediately after the push, the integer resides in register ST(0). The second integer is referenced where it resides in memory and added to the first inside register ST(0). After the operation is completed, the result is written back to memory where the CPU can access it. The CPU can't access data directly in a coprocessor register the same way it can access data in its own internal registers, so RAM is used as a go-between. Though memory locations can be referenced in NDP instructions, the coprocessor has no ability to decode addresses on its own.

The 8087, which has its own data and address lines, uses 20-bit physical addresses generated by the 8086/8088 to fetch data from memory. The 287 and 387 are different. They rely on the CPU to fetch the data for them. This arrangement insulates them from the intricacies of real- and protected-mode memory addressing and eliminates the need to carry redundant addressing logic on board two separate chips.

The 80x87 implements seven different data types. Three classes of integers—word, short, and long—account for three of them. Word integers occupy 16 bits and can hold values ranging from -32,768 to 32,767. Short integers occupy four bytes of storage and span the range from -2,147,483,648 to 2,147,483,647. Long integers require 8 bytes and can hold values so large that you'll probably never need them in integer format.

Reals account for another three of the

seven 80x87 data types. They conform to the IEEE format for representation of floating-point numbers, and they come in three varieties: short, long, and temporary. The difference between short and long reals is that short reals require 32 bits for storage while long reals require 64. Short reals can be used to represent numbers (positive and negative) as small as $10E-37$ and as large as $10E+38$. Long reals can hold values ranging from $10E-307$ to $10E+308$. Temporary reals are 80 bits long and exist only inside the 80x87.

The final data type, packed decimal, provides a means for storing integers in a COBOL-compatible 80-bit binary format. The lower 72 bits contain 18 sets of 4 bits that each hold a binary value from 0 to 9 representing one decimal digit. Bit 79 (the highest bit) holds the sign. Bits 72 to 78 are unused.

The ability to deal with a variety of data types isn't the only advantage the NDP offers over standard CPUs. One of its primary benefits is that its instruction set is optimized for number crunching. Not only can many operations be performed with a single instruction (making them much easier to code), they're performed fast, consuming far fewer clock cycles than would equivalent routines coded on a conventional CPU. The FPATAN instruction, for example, calculates the arctangent of an angle. The equivalent routine coded for the CPU would be hundreds or perhaps thousands of lines long. In addition, a number of commonly used mathematical constants such as the value of pi are built in.

So what's the best way to write code that takes advantage of math coprocessors? Far and away, it's easiest to use a compiler. Most compilers will generate 80x87 code for you or optionally substitute calls to an 80x87 emulation library. The compiled program will automatically detect the presence or absence of an NDP and adjust its computational methods accordingly.

For example, programs compiled with Microsoft C 5.1 using the /FPi switch will use a coprocessor if it's available or, at runtime, default to equivalent routines coded for the CPU if one is not. If you wish, you can compile with the /FPi87 option, which generates in-line 80x87 code that will run only on machines equipped with a coprocessor. Which option is right depends on the audience your program is targeted for and how well the program performs without a math coprocessor.

AutoCAD is one of the very few appli-

cation programs that require a coprocessor. Its operations are so math-intensive that without help from a specialized floating-point unit, its speed would be so inhibited that its benefits would be marginal.

If you choose to go the assembly language route, you'll have to code coprocessor instructions the old-fashioned way—by hand. You'll also have to include code to detect the presence or absence of a coprocessor. Trying to execute coprocessor instructions when a coprocessor isn't there will lock up some CPUs. To understand why, consider the code shown in Figure 3, a disassembled version of the ex-

MASM COPROCESSOR CODE

```
WAIT    FILD    WORD PTR [INT1]
WAIT    FIADD   WORD PTR [INT2]
WAIT    FISTP   WORD PTR [SUM]
        RET
```

Figure 3: By default, MASM inserts a WAIT instruction before every coprocessor instruction to make sure that another instruction isn't fetched while the coprocessor is still chewing on the last one. Shown here is the code produced by MASM for the routine shown in Figure 2.

ecutable file produced from the source code in Figure 2.

MASM automatically places a WAIT instruction in front of every NDP instruction to prevent the CPU from fetching another instruction while the coprocessor is busy executing the last one. WAIT causes the CPU to pause until its TEST line (the BUSY line on the 286 and 386) is asserted. To let the 80x86 know when it's busy, the 80x87 inhibits the TEST line when it starts executing an instruction and asserts it when it's done. If you execute a WAIT on a machine that isn't equipped with a coprocessor, the CPU will hang, looping endlessly while it waits on the signal to proceed from a coprocessor that isn't there.

You can disable MASM's insertion of WAIT instructions by placing a .286 or .386 directive in the source code. The 286 or 386 synchronize instruction fetches automatically with the 287 or the 387, so WAITs aren't needed unless there's a chance that the two processors will attempt to access the same memory location at the same time.

Figure 4 shows a short cookbook code sequence you can use to determine whether or not an 80x87 is installed. The co-

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Tutor

DETECTING THE PRESENCE OF A MATH COPROCESSOR

```
check87    proc far
            xor ax,ax                ;Assume no 80x87
            mov word ptr [cword],ax ;Zero receiving word
            fninit                   ;Initialize 80x87
            fnstcw word ptr [cword] ;Transfer control word
            cmp byte ptr [cword+1],3 ;80x87 is present if the
            jne no_87                ; upper half of the
            inc ax                   ; control word is 3
no_87:      ret                     ;AX = 0: no 80x87
            ;AX = 1: 80x87 installed
check87    endp
```

Figure 4: CHECK87 checks for the presence of an 80x87 math coprocessor by initializing it (if it's there) with an FNINIT instruction and transferring the coprocessor control word to memory. The upper byte of the receiving word will be 3 if a coprocessor is installed. AX returns 1 if there is an 80x87 installed, 0 if not.

processor is initialized with an FNINIT instruction, and the coprocessor control word is transferred with an FNSTCW instruction to a word-size memory location that was previously zeroed. Afterwards, if a coprocessor is installed, the upper byte of the receiving word will be set to 3. If no coprocessor is present, the byte will still be 0. In the event that no coprocessor is installed, the FNINIT and FNSTCW instructions will not hang the system. The N in these instructions stands for "no-wait," so MASM doesn't insert a WAIT instruction in front of them—even on 8088s and 8086s.

Those of you who would like significantly more detail on the subtleties of coprocessor programming techniques should check out Ray Duncan's recent seven-part series on arithmetic routines in his Power Programming column, (*PC Magazine*, November 14, 1989, through March 13, 1990).

VGA BORDER SUPPORT

Does the VGA support borders like the CGA does? If so, how can you display a border? And are you restricted to just 16 border colors, or can you use the VGA palette and color registers to access more?

John C. Wagner
Gainesville, Florida



The VGA does indeed support a border. It's not nearly as robust as the one on the CGA, but it's much better than the infamous EGA border. Programmed with the default CRT Controller parameters, a text-mode VGA displays a border roughly one character wide all the way around.

The border color is set by writing a value to the VGA's 8-bit Overscan Color Register. The easy way to do this is through function 10h of the video BIOS. Set AH to 10h, AL to 01h, and BH to the border attribute you want, then execute an interrupt 10h. The border will appear in the color you specified.

An 8-bit value gives you a full range of 256 different border attributes to choose from. But you're not limited to 256 colors. The value in the Overscan Color Register is really a color register address, so you can set the border color to any of the more than 256,000 colors the VGA supports by programming the color registers accordingly. Unlike text-mode attributes, there is only one level of indirection in the route a border attribute takes to becoming a color; it is not funneled through the VGA palette registers. As a result, changing the palette registers will not affect how the border is displayed.

[For a much more detailed study of the VGA, refer to the Utilities column in the October 17, 1989, issue of PC Magazine.—Ed.]

ASK THE TUTOR

The Tutor solves practical problems and explains points of general interest about using your hardware and software more productively, and answers basic questions about DOS and systems in general. To have your questions answered here, write to Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modern" sidebar in the Utilities column). We're sorry, but we cannot answer questions personally. ■

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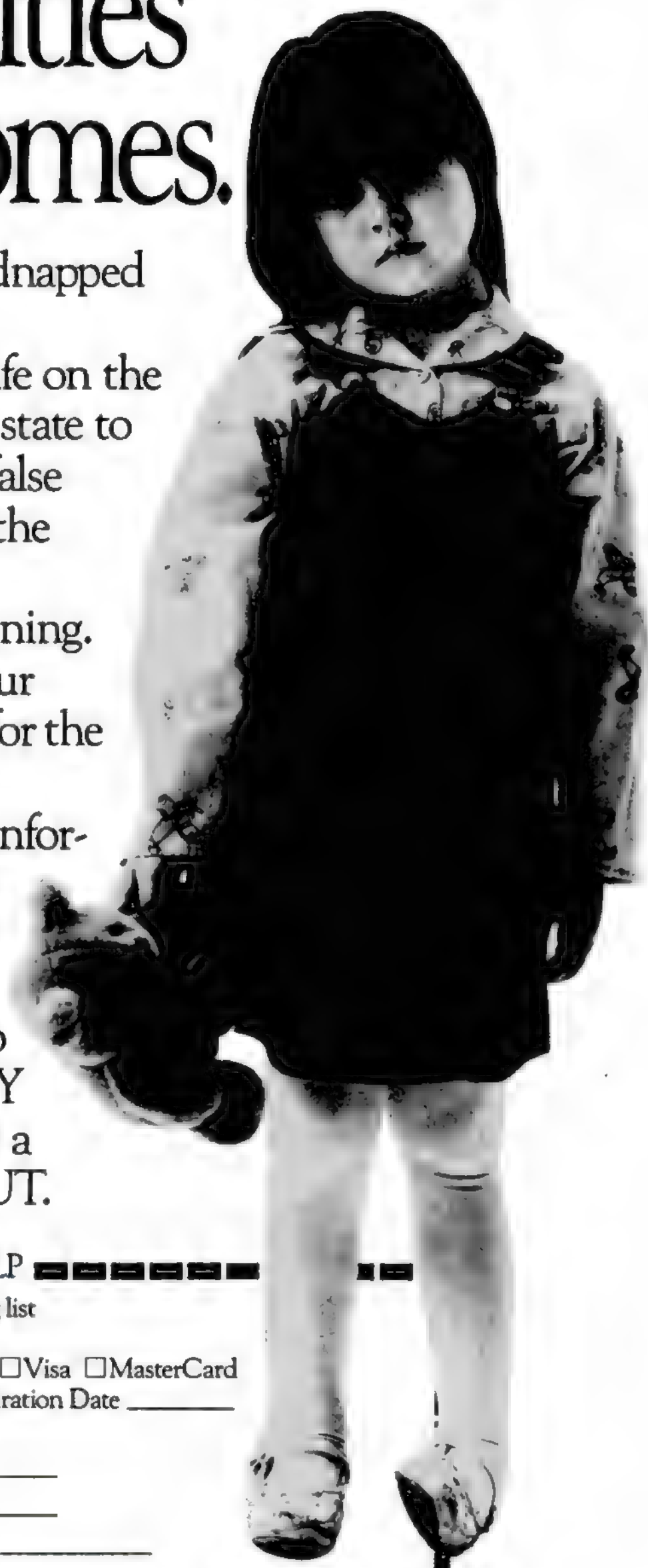
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major competitors. The result: UDS tops the field in weighted average score for five important parameters! *PC Week* cites the V.3225's "blazing speed, plus excellent front panel menu and status display" as evidence of the modem's merit.

In earlier evaluations, *PC Magazine* honored the original UDS V.32 with an Editors' Choice Award and referred to V.3225s as, "the last modems you'll ever buy

because they make optimum use of both voice phone lines and the PC's serial port."

Besides technical leadership and outstanding performance, every modem in the UDS V.32 family offers **unconditional** compliance with the full V.32 standard. Learn how the UDS commitment to V.32 can increase your datacomm throughput over dial-up lines: contact Universal Data Systems, 5000 Bradford Drive, Huntsville, AL 35807-7002. Telephone 205/721-8000; FAX 205/721-8926.



Universal Data Systems



MOTOROLA INC.

by
Frank J. Derfler, Jr.

Connectivity

ENHANCING CONNECTIVITY

There is nothing like raising a religious issue to move the silent majority to speech. Repeaters, bridges, routers, and brouters seem to fall into the category of LAN dogma. And, just as in religion and politics, you can be pilloried as much for what you don't say as for what you do say.

BURNING BRIDGES

I've heard from several folks who didn't quite (or at all!) agree with my definitions of these devices in *Connectivity Clinic*, November 28, 1989. Some rewrote my definitions and others expanded them at length.

While the people who wrote didn't always agree with each other, it does seem that my simple definition of a bridge steps on the accepted definition of an Ethernet repeater. That is, a device that connects two identical LANs and repeats every packet without discrimination. My error.

The working definition of a bridge, however, seems to cover a lot of ground. Several people pointed out that a MAC layer bridge doesn't have to connect networks using different kinds of cabling, but I didn't say it did. I said it *can* link dissimilar cabling systems, and that's an increasingly important capability for many readers. Others said the term *media access control (MAC) layer bridge* is redundant because a bridge always functions at the media level.

One reader thinks I should have made it clear that routers operate at the network layer of the Open Systems Interconnection (OSI) model instead of at the data-link layer of that model where routing bridges operate. The distinction concerns which part of the message the router or routing bridge reads in order to route the packet to its correct destination. There's a lot more we could say about routers, but the definition changes depending on the network.

As Joseph Wiesenfeld of Massachusetts wrote, "The most important point to be made is that these terms have gotten multiple definitions and usages." Amen!

■ **ENHANCING CONNECTIVITY:** A closer look at some terms and products that further communication.

MONITRIX REPORTS ON NETWARE

Speaking of religion, there's a product that gives you a "God's eye" view of a Novell network, which every *NetWare* administrator and LAN heavyweight should know about. *Monitrix*, from Cheyenne Software ((800) 243-9462), is one of the few successful Value Added Processes (VAPs) for *NetWare* servers.

Monitrix has the look and feel of Novell's own *NetWare* utilities. It sits in the server and checks just about everything worth checking on a network. A software package running in a client workstation displays the data the VAP collects. It lets you see real-time statistics for any node on the network and reports on the complete hardware configuration of each node. You can tell which version of driver software and *NetWare* shell each station has loaded, and remotely generate point-to-point tests to check for cable and adapter problems. It's easy to spot bad cables and adapters in the statistical reports.

We use it in the *PC Magazine* LAN Labs and find that while it increases CPU utilization on the server by about 4 to 5 percent, it doesn't seem to impact server throughput to any degree we can measure. The package has lots of other nifty features, including the ability to draw a logical diagram of the network. I haven't quite figured the value of that capability, but it impresses visitors. Overall, *Monitrix* is worth its \$795 price and is a valuable addition to every LAN power user's toolbox.

THE V.42bis STANDARD

The gurus meeting in standards committees, cloistered in their ivory towers, often forget that real people must make buying

decisions for products that use the standards they develop. They issue standards with a seemingly endless stream of numbers and strange suffixes and expect us to keep the incantations straight. The latest of these that you'll read about in modem ads is V.42bis. (CCITT, Comité Consultatif International Télégraphique et Téléphonique, which sets international communications standards, is based in Geneva, Switzerland. Hence the extension *bis*, a French term denoting an improved version.)

Many of you know that modems conforming to the V.22bis standard use a modulation-signaling scheme that allows the exchange of data at up to 2,400 bps. If you're a regular reader of this column, you also know that we often mention the value of V.32-standard modems using a modulation-signaling scheme that operates at up to 9,600 bps for shared LAN modem pools. So you'll logically assume that V.42bis is some faster modulation scheme. Sorry, in this case logic doesn't work. The V.42bis standard, not to be confused with the plain V.42 error-control standard, defines a data compression scheme. Like Microcom's MNP 5 protocol, V.42bis lets you move files across a communications line faster than the modem's signaling scheme would normally allow. For example, if your modem uses V.32 signaling at 9,600 bps, adding the V.42bis compression scheme increases apparent throughput to as much as 30 kilobits per second with text files and 38 kilobits per second with highly compressible data like spreadsheets.

Hayes sells V.42bis chip set upgrades for many of its modems, and new modems from Hayes, UDS, and other companies feature both MNP 5 and V.42bis compression. While V.42bis gives better compression and therefore better throughput, a large base of modems equipped with the MNP 5 protocol exists, so retaining this capability is important to many people.

The point to note here is that V.42bis defines a compression scheme that works in conjunction with the V.42 error-control

Connectivity

protocol. Firmware that follows the V.42bis standard can improve the effective throughput of modems using many different types of signaling schemes, including V.22bis and V.32.

Figure 1 shows some of the common protocols associated with modems. You'll find it useful in sorting out your buying decisions.

MICRO-TO-MAINFRAME OPTIONS

The folks from Memorex-Telex visited PC LAN Labs recently to discuss PC-to-IBM mainframe connection options and the line of products it calls "Network Controllers." A Network Controller, as the company defines it, is a substitute for an IBM 3174 Terminal Cluster Controller, and much more.

In the typical PC-to-IBM mainframe connection scheme, PCs use special internal adapters (such as the ubiquitous DCA IRMA card) and 3270 terminal emulation software to connect to one of the IBM 3x74 Terminal Cluster Controllers. The Cluster Controller regards the PC as a permanently connected terminal. This scheme works well, but it's expensive because it eats up connections on the cluster controller and requires special hardware in every PC.

An alternative is to use a new or existing LAN to link all the PCs to a single machine acting as a gateway to a terminal cluster controller or front-end processor. A dozen or more PCs acting as terminals can work through this gateway with one connection to the mainframe. This architecture saves on mainframe hardware expense, but it does require the resources of a LAN. SNA gateways are relatively easy to install and are particularly attractive if you have an ARCnet or Ethernet network. We last reviewed SNA gateway products in the November 29, 1988, issue of *PC Magazine*, and they haven't evolved much since then. But if you intend to install a Token-Ring network, IBM has a special plan for you.

The latest trend in PC-to-IBM mainframe links is to create a Token-Ring LAN with the PCs and elements of the mainframe, usually the front-end processor, interacting as peers on the network. The appealing logic of this architecture is that a network of interconnected peer nodes is the best way to implement shared-resource computing applications. However, the ini-



MODEM PROTOCOLS

MODULATION PROTOCOLS:

V.32	Transmission at up to 9,600 bits per second
V.21	Transmission at up to 300 bits per second
V.22	Transmission at up to 1,200 bits per second
V.22bis	Transmission at up to 2,400 bits per second

ERROR-CONTROL PROTOCOLS

V.42	Detects and corrects transmission errors; includes compatibility with MNP levels 2 to 4.
MNP 2-4	Detects and corrects transmission errors; MNP standards do not include full V.42 compliance.

DATA-COMPRESSION PROTOCOLS

V.42bis	Provides compression as great as 4 to 1 on some files; does not in itself include MNP 5 compatibility.
MNP 5	Provides compression as great as 3 to 1 on some files; not related to V.42bis, but they often appear in the same modems.

Figure 1: A variety of CCITT V. standards as well as Microcom MNP standards apply to modems.

tial hardware package needed to connect a mainframe element to the Token-Ring costs several thousand dollars, and the constant interaction with the separate SNA Physical Units on the network loads the mainframe's communications processor.

The Memorex-Telex 1174 Network Controllers can connect up to 96 terminals and PCs acting as terminals to a maximum of four hosts. The 1174 series of products

a lot of SNA physical units.

We've received several letters from people with large installations of 3270 terminals asking how they can run PC applications. Since the 1174 can connect to ASCII devices, you can use it to link 3270 terminals to the RS-232C port of a machine using a multitasking DOS system such as *Concurrent DOS 386*, *PC-MOS Multiuser*, *Quick Connect/386*, *386/MultiWare*, or *VM/386 MultiUser*, all reviewed in the September 12, 1989, issue. This lets you keep down the number of monitors and keyboards on each desktop.

Prices for the 32-connection Memorex-Telex 1174 start at about \$10,900, so it provides an economical alternative for many people exploring PC-to-mainframe connection options. For information, call Memorex-Telex at (800) 950-3465.

NETWORK YOUR QUESTIONS

Connectivity gives you practical solutions to networking problems of all types. We'll pay \$50 or more for any tips we print, *plus an extra \$25 if you submit your letter on a disk*. If you do, please include a printed copy. We'll gladly answer your questions at no charge, but we cannot answer letters personally. Mail contributions to Connectivity, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column). You may also contact Frank J. Derfler, Jr., via MCI Mail (use Derfler's box named PC MAGAZINE LAN LABS).

A network of interconnected peer nodes is the best way to implement shared-resource applications.

contains several different Intel and Motorola microprocessors that handle communications tasks. The Network Controllers are very flexible and you can use them in many different ways.

An 1174 can simultaneously act as a controller for directly connected PCs, as a connection point for LAN gateways, and as a mainframe connection point on a Token-Ring network. The 1174 can save the more-expensive mainframe communications hardware from the task of handling

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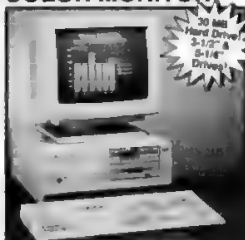
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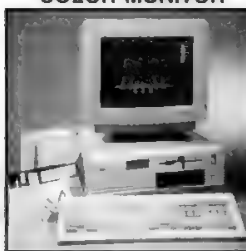
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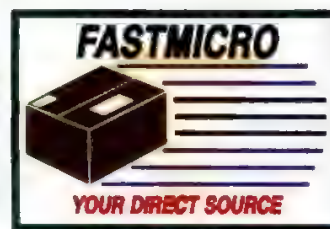
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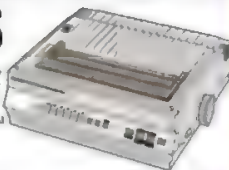
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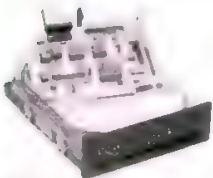
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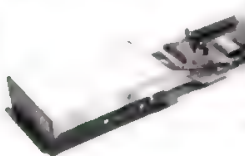
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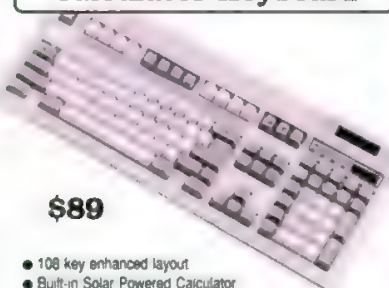
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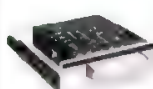
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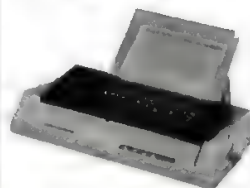
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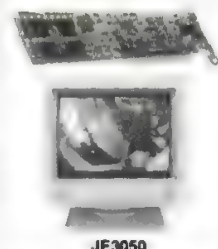
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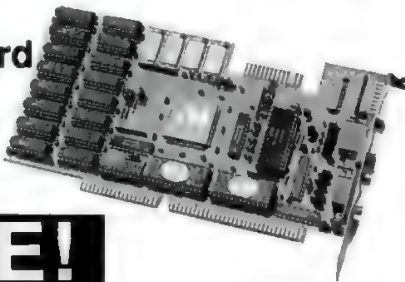
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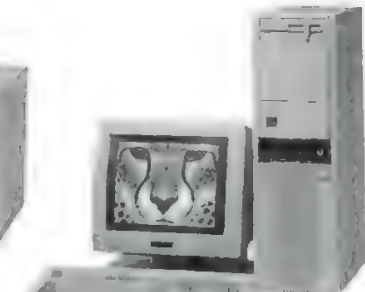
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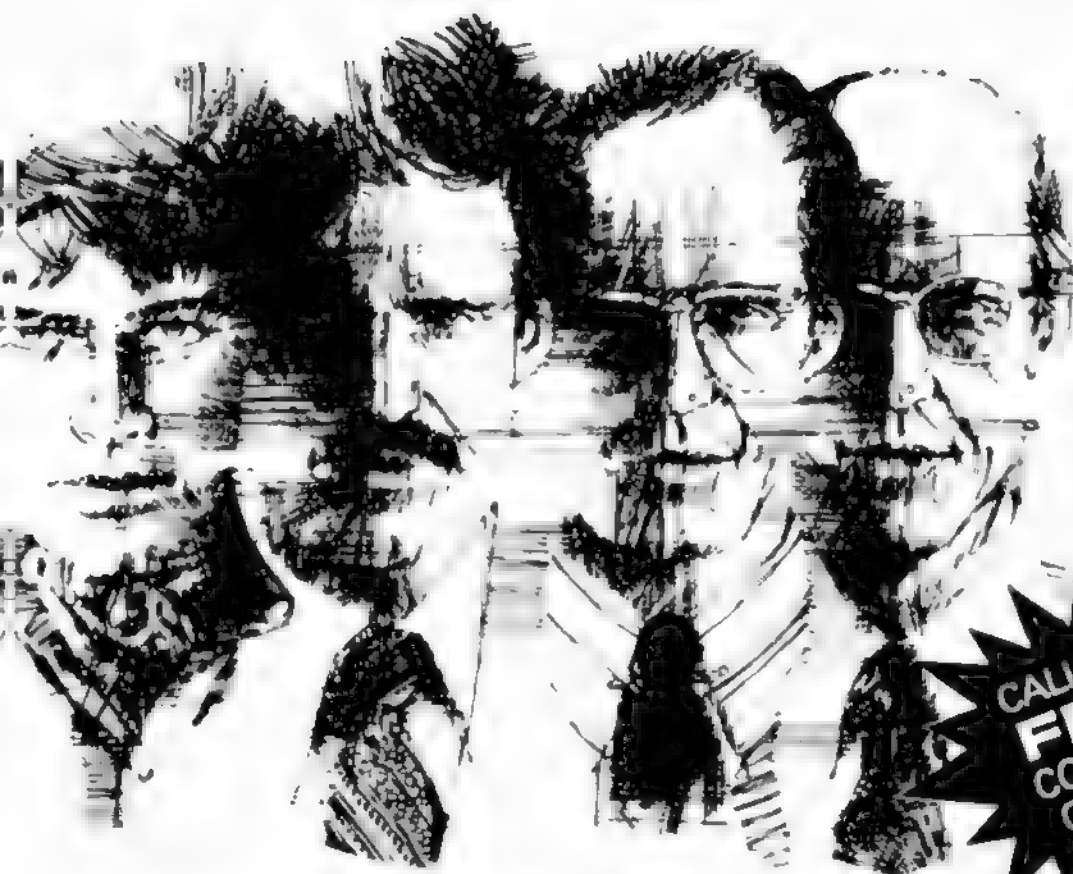
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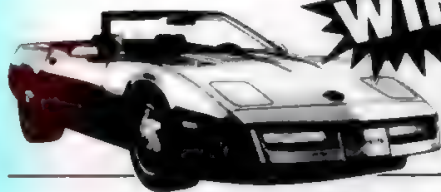
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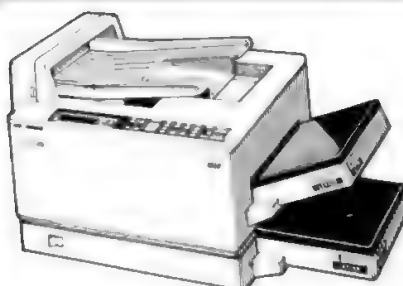
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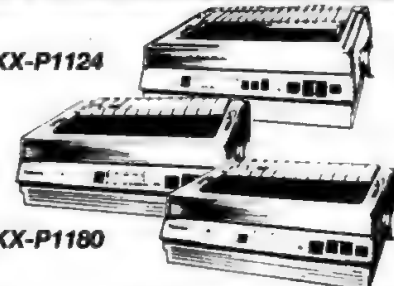
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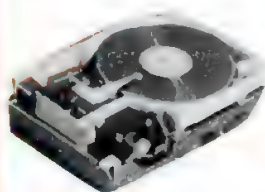
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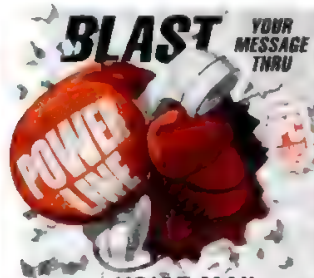
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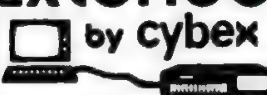
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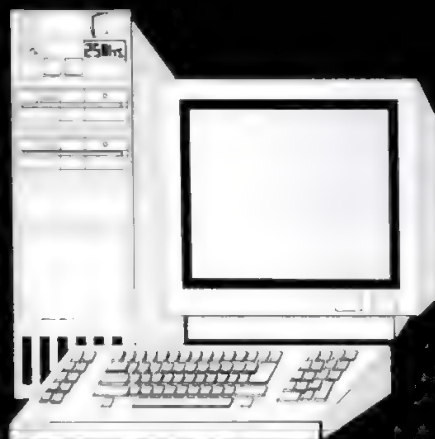
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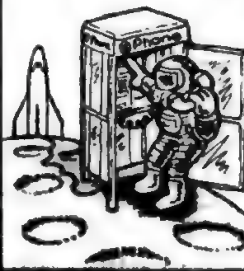
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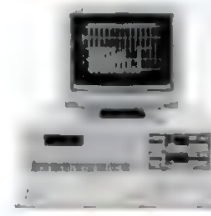
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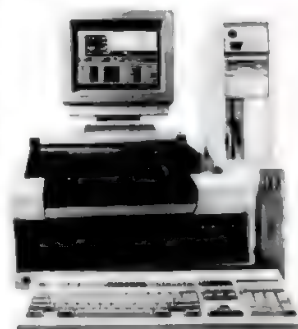
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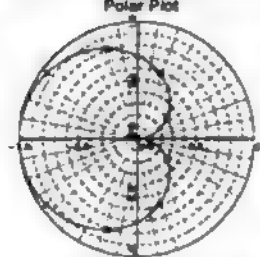
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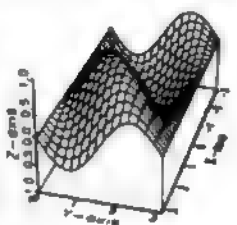


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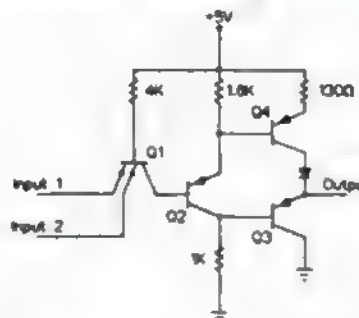
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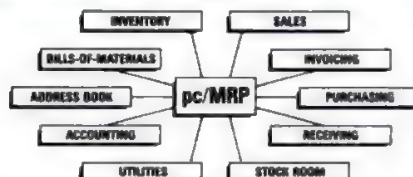
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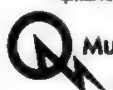
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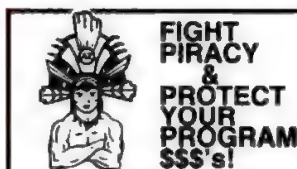


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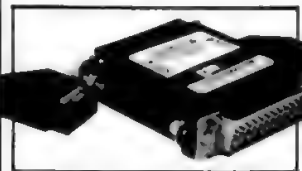
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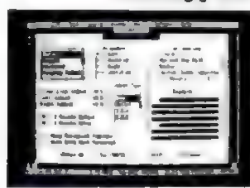
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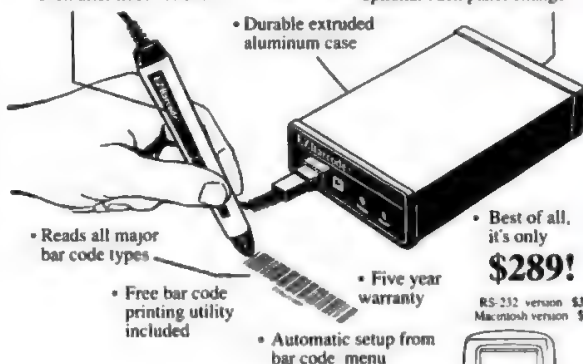
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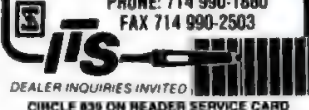
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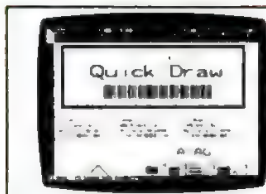
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- m. ☐ 26-100
- n. ☐ 100 or more

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- o. ☐ Linked to mainframe
- p. ☐ Linked to mini
- q. ☐ Networked together

6. Does your company own

- r. ☐ Mainframe(s) t. ☐ VAXes
- s. ☐ Mini(s)

7. Do you plan to buy any PC product?

- u. ☐ Now
- v. ☐ In 4 to 6 months
- w. ☐ In 6 to 12 months
- x. ☐ No definite plans

8. Number of employees in your entire company?

- y. ☐ 25 or less z. ☐ 500-999
- 1. ☐ 26-99 3. ☐ 1000 or more
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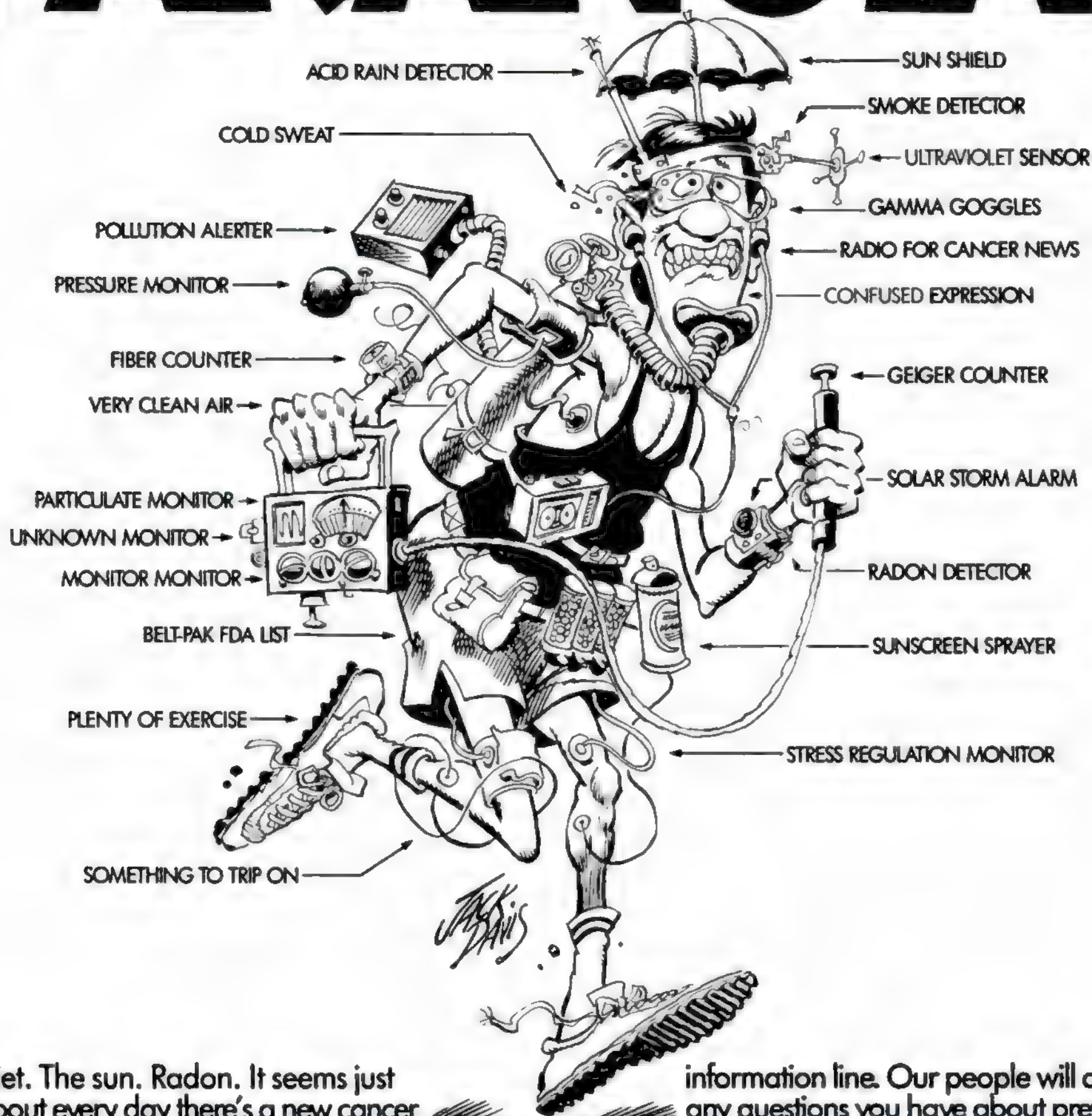
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■ UTILITIES EVERYONE NEEDS

Contributing editor Edward Mendelson sets out to solve all his computing problems with the latest versions of *Mace Utilities*, *The Norton Utilities*, and *PC Tools Deluxe*.

■ THREE-DIMENSIONAL CADD PACKAGES

Navigating the complexities of high-end, 3-D CADD packages is a challenge, even for the most talented mechanical engineers. Contributing editor Jeff Prosis and a team of reviewers evaluate 12 packages, including new versions of *Anvil-5000PC*, *AutoCAD*, *Cadkey*, and *Drawbase 5000*.

■ DESKTOP PLOTTERS

In this age of sharp laser printers and increasingly inexpensive color page printers, do desktop plotters still have relevance? Absolutely, especially for businesspeople who want to put their charts and graphs on paper or on transparencies for overhead projectors. PC Labs tests ten desktop plotters, including models from Hewlett-Packard, Hitachi, and Roland.

■ ENDURANCE TESTS, PART 2

Once again, *PC Magazine's* editors report on what it's been like to live for six months or more with some top products, this time in the graphics categories of illustration software, PostScript boards, printer-enhancement boards, mice, presentation graphics software, and 8514 monitors.

■ WIDE-AREA INFORMATION TRANSFER SYSTEMS

Picture this: you own ten stores around the city. Each night, your computer dials up PCs in each store and downloads the day's financial and inventory reports. In the morning, detailed reports are waiting to be read. From Mrs. Fields Cookies to K-Mart, wide-area information transfer is a daily fact of life. PC LAN Labs evaluates four products, ranging in price from \$30 to \$300 per station. ■



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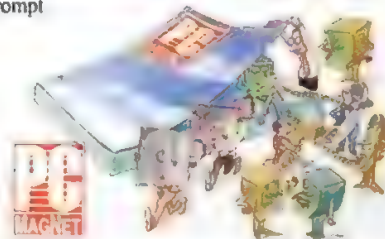
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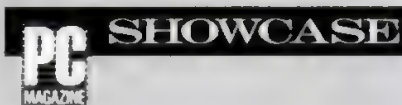
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After Hours

Products for the Leisure Side of Personal Computing

As April Approaches: Three More Personal Income Tax Programs

PERSONAL FINANCE
by Laura Lou Meadows

In this issue we continue our look at income tax preparation software. We also examine the issues involved in taking a deduction for your home computer (see the sidebar "The Price Waterhouse Report"), and take a peak at some of the software that the tax pros use (see the sidebar "What the Pros Use: Two Heavy-Duty Tax Prep Packages").

MacInTax For Windows

When Softview's *MacInTax for Windows* lights up the screen with its graphics replica of a Form 1040, the effect is dazzling. This virtuoso turn is followed by comparable screen

pyrotechnics for all 34 IRS forms and schedules supported by the rechristened program, which was called *TaxView* when we reviewed it here last year (*PC Magazine*, March 14, 1989). This is true WYSIWYG raised to the ultimate.

If you've grown accustomed to the charms of *Microsoft Windows* and acquired a mouse, *MacInTax* is the program to take advantage of them. On my 286-based clone, the graphics screens took several beats to redraw when I scrolled past the edges, but this slight delay probably disappears if you run the program on a muscular 386 machine.

As you might expect, from great graphics screens follow great graphics printouts of submittable IRS forms, both for dot matrix printers and for lasers. The program comes with its own

set of downloadable soft fonts; the laser output beautifully replicates all of the IRS forms in the program.

Though I was entranced with its California good looks, I was less enchanted by how *MacInTax* dealt with the tax information I typed in. The program lacks an interview to alert you to the supporting forms or schedules you may need. Even if your facts clearly require a form beyond the basic 1040—and the program has already computed it—*MacInTax* doesn't tell you. You must figure out for yourself that you need to file a self-employment tax schedule or an underpayment penalty tax form and choose that form from the menu. After you open the form, you may find that the program has already filled in the numbers from your other entries. But if you're not aware that you should pick the form from a forms menu, a required form will not print and nothing on the screen tells you what you're missing.

MacInTax supports electronic filing through a San Diego transmitter, *InstaTax*. You mail them your tax return file on a disk, along with your signed Form 8453 Declaration of Electronic Filing (which the program prints), your W-2 forms and a credit-card authorization or check for \$29.95. *InstaTax* will file electronically for you and, if you qualify, even arrange for you to get a refund anticipation loan within as little as three days of the time it receives your disk.

PERSONAL FINANCE

MacInTax for Windows brings tax prep to the graphical interface.

Swiftax makes short work of less complicated returns.

TaxShop 1040 emphasizes electronic filing.

List Price: *MacInTax for Windows*, \$99; \$79 for each of 8 state programs; federal renewal for registered users, \$55; state renewals for registered users, \$40. **Requires:** 80286- or 80386-based PC, 640K RAM, *Microsoft Windows 2.0* or later (*Windows* runtime available for \$10), hard disk, graphics adapter, DOS 3.0 or later. Softview Inc., 1721 Pacific Ave., #100, Oxnard, CA 93033-1884; (805) 385-5000.

CIRCLE 615 ON READER SERVICE CARD

Swiftax

Swiftax is fine, easy to use software for the individual whose tax picture is not too complex. Its initial interview asks questions that help determine whether you are eligible to file a Federal Form 1040EZ or 1040A. If you are relegated to the 1040, the interview tells you which additional forms or supporting schedules you may need, and checks them off on the Forms Menu. You can refer back to the Forms Menu later to be sure that you've attended to all of the necessary paper work.

Swiftax offers a host of features that simplify the once-a-

CONTINUES

The screenshot displays the MacInTax software interface. At the top, there's a menu bar with 'File', 'Edit', 'Forms', 'Schedules', 'Worksheets', 'Statements', and 'Help'. Below the menu bar, a window titled 'MacInTax for Windows' is open. Inside, there's a form titled 'Form 8453: Eileen Filion Declaration' and 'U.S. Individual Income Tax Declaration for Electronic Filing'. The form includes fields for 'Your first name and initial', 'Last name', 'Your social security number', 'Spouse's first name and initial', 'Last name', 'Spouse's social security number', 'Home address (number and street)', 'Apt. no.', 'Telephone number (optional)', 'City, town or post office, state, and ZIP code', and 'For Paperwork Reduction Act Notice, see instructions'. The form is filled out with sample data for Eileen Filion. At the bottom, there's a status bar with the text 'The taxpayer's name changed during the past 3 years due to marriage, divorce, etc., and he or she filed a Federal Income Tax return for each year ending the number years prior to the most recently used here.' and 'Eileen J. Filion'.

MacInTax For Windows includes a WYSIWYG image of the declaration you must sign in order to file electronically.

WHAT THE PROS USE: Two Heavy-Duty Tax Prep Packages

by Laura Lou Meadows

To get an idea of how personal tax software compares with full-scale professional programs, I looked at two packages intended for the tax-preparation professional. Arthur Andersen's *A-plusTax* is the only program developed by a major national accounting firm that is also available for sale to the public. The *Lacerte Individual Tax Program* is one of the half-dozen most widely used professional programs, and one of the most expensive.

At \$1,500 for the federal Form 1040 package, *A-plusTax* does over 50 IRS supporting forms and schedules and a goodly number of worksheets. On the supporting forms, it actually does most of the subsidiary calculations, instead of simply providing a template on which to enter the results of manual calculations. This is intended to save the tax accountant time and money in the long run.

With laser-printer drivers (priced at \$500), a laser printer and a tax font cartridge, the program prints authentic replicas of all supported IRS forms. *A-plusTax* also handles many business housekeeping functions such as special reports, batch input and printing, client letters, filing instructions and invoices. Like several other packages I reviewed, *A-plusTax* wasn't quite out of beta testing by our publication deadline. I visited the *A-plusTax* people in their Florida laboratories to watch as the finishing touches were applied.

A-plusTax offers a choice of three styles of data entry, including batch entry from previously filled-out data sheets. This represents a noble effort on the part of Andersen's designers to adjust to a practitioner's preferred

slow recalculation time and its awkward and opaque screen conventions, however, it lumbers along like a gold-plated dinosaur.

Lacerte (\$2,000 for the 1040 package) does 38 IRS forms and schedules, per-

ceptionally concise and pertinent help windows for each line. The software doesn't just inundate you with help; instead, the information appears in a useable context, with explanations of what to enter. You also learn where and how your answers will be used, not only at the entry point but also elsewhere in the program. Despite the helpful on-screen documentation, however, it can be awkward and time consuming to keep track of where all your input is taking you.

Lacerte also lags when it comes to calculation time. In fact, the program needed 2MB of hard disk space and several minutes just to calculate the federal tax for my sample scenario. This is on top of the 4MB of hard disk space the program eats up for storage.

As with the Arthur Andersen program, the snail's pace of the calculation and printing steps comes from the program's being written years ago, when BASIC was the programming language of choice. "If it ain't broke, don't fix it," I was told when talking with *Lacerte*.

Lacerte is a first-rate program in many respects, but woefully short of the speed and efficiency that today's tax professional is entitled to expect for the hefty price. Both *Lacerte* and *A-plusTax* lack the basic performance and user interface innovations of personal programs costing much less. These professional packages have features accountants require, but they could both benefit from thorough revision. ■

Both *Lacerte* and *A-plusTax* lack the basic performance and user interface innovations of personal tax prep programs that cost much less.

method. But *A-plusTax* has not aged well since its introduction a number of years ago. The software is written in a variant of BASIC, and its user interface strikes me as a relic from the bad old days of abstruse and unnecessarily cumbersome mainframe applications. *A-plusTax* forces the tax practitioner to substitute memorization and training time in place of many efficiencies that could be written into the software and put on the screen. And recalculation time is slow; a 386 machine is a virtual necessity for efficient use of *A-plusTax*.

The next rewrite is likely to be coded in a more modern programming language, and, it is hoped, will incorporate an up-to-date interface. Meanwhile, in terms of the extent and depth of its forms and features, *A-plusTax* is a fine tax-preparation program. With its agonizingly

forms many special calculations automatically and in great detail, and turns out client filing letters and bills.

As with most professional programs—including *A-plusTax*—*Lacerte* has a batch input mode that allows the knowledgeable tax specialist to enter tax data by hand on input sheets. The sheets are then turned over to a data entry clerk—totally innocent of tax background—to enter into the computer. A fair amount of training of the tax professional and rote learning by the data processor is necessary to get up to speed with input sheets and batch processing.

A touch of the F5 key switches the software to its interactive mode, and here *Lacerte* really shines. A completely different set of screens comes up, labeled with recognizable terms and explanations.

A tap of F1 invokes ex-



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After Hours

TAX-PREPARATION PROGRAMS: SUMMARY OF FEATURES							
(Products listed in alphabetical order)							
	AM-Tax \$45.00 (regular) \$60.00 (advanced)	Andrew Tobias' TaxCut \$79.95	J.K. Lasser's Your Income Tax \$79.95	MacinTax for Windows \$99	Swiftax \$69.90	TaxShop 1040 \$69 (personal) \$399 (professional)	TurboTax \$75
Number of optional state-tax modules	8	8	3	8	None	33	41
Includes preliminary interview to determine forms needed	☐	☒	☒	☐	☒	☒	☒
On-screen help:							
Operational help	☒	☒	☒	☒	☒	☒	☒
Tax help	☐	☒	☒	☒	☒	☒	☒
Pop-up calculator or worksheet	☒	☒	☒	☒	☒	☒	☒
Prints submittable Form 1040:							
On a laser printer	☒	☒	☒	☒	☒	☒	☒
Requires font cartridge	☒	☐	☐	☐	☐	☒	☐
Requires additional software	☐	☐	☐	☐	☐	☒	☐
On a dot matrix printer	☒	☒	☒	☒	☒	☒	☒
Includes electronic filing	☒	☒	☒	☒	☐	☒	☒
Imports data from financial programs	☐	☒	☒	☒	☒	☐	☒
Calculation can be overridden	☒	☒	☒	☒	☒	☒	☒

■—Yes □—No

Tax Preparation

CONTINUED

year exercise of completing your tax returns. The well-designed user interface incorporates pull-down menus, a pop-up calculator, a status line at the top of the screen, and on the bottom of the screen a context-sensitive func-

tion-key menu. Need help? You can call up on-screen operating instructions or windows with condensed IRS tax instructions. If you want a brief explanation of a tax concept, you can choose from a list of tax topics. If you absorb material better from hard copy, you can refer to the small

but lucid manual, which admirably sets forth the mechanics of *Swiftax's* operations.

As you work along, the program holds figures in memory so that recalculation is instantaneous as you add each new number. At any point you can choose to view a tax summary

window (based on your entries to date) by pressing Alt-T.

In many ways *Swiftax's* operation resembles that of several other tax programs, but differences crop up when you work with advanced concepts like depreciation, partnership interest, or passive activities. For example, the program contains a Form 4562 for reporting depreciation, but *Swiftax* leaves you to do much of the work. After you fill in all the background information on Form 4562, you still have to find the right formula, compute the amount of the depreciation yourself, and enter your answer on the screen. A number of other tax programs in the same price range—*TurboTax* and *TaxCut* to name two—perform this sticky calculation for you, once you've supplied the basic information. To its credit, *Swiftax* can pick up numbers from other programs such as *Quicken*, *Managing Your Money*, and *Lotus 1-2-3*, and from ASCII files. Up to five items can be totalled and placed on the appropriate line of the tax form.

Swiftax prints a submittable

Swiftax is a good tax-preparation solution for individuals with relatively simple returns. Some fairly difficult calculations are left for the user, however.



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After Hours

graphic Form 1040. One of these came out nicely on my laser printer without any special font cartridge or extra software. The printout did take a little longer than similar output from other programs. The program will also print the form on a dot matrix printer. *Swiftax* has no state income tax programs at this time and does not support electronic filing. If you don't anticipate a complicated return, *Swiftax* will do a competent job of preparing you for this April 15.

List Price: *Swiftax*, \$69.90; half price for registered users.

Requires: 512K RAM, two disk drives (hard disk recommended), DOS 2.0 or later. Timeworks Inc., 444 Lake Cook Dr., Deerfield, IL 60015-9842; (708) 948-9200.

CIRCLE 616 ON READER SERVICE CARD

For a surprisingly low price, **TaxShop 1040** generates high-quality form replicas and offers electronic filing.



TaxShop 1040

As far as it goes, *TaxShop 1040* is a very good tax-return program. Like *Swiftax*, it does not

get down to the nitty gritty of calculating depreciation or passive activity losses (after all, the folks at TenKey Publishing had to save some features for their

\$399 professional version). But *TaxShop* offers excellent graphic reproduction of tax forms and provides for electronic filing. It supports over 30 IRS forms.

THE PRICE WATERHOUSE REPORT: Despite Stringent IRS Rules, Your Home PC May Still Be Deductible

by Stephen A. Terry, CPA, and William P. Daly, CPA

The rise of home computing is attracting Internal Revenue Service scrutiny of computer business-use tax deductions. While deductions are still available for legitimate business use of home computers, employees who use their home PCs for job-related work must be aware of recent IRS rulings and court decisions. A tax deduction is not necessarily acceptable to the IRS just because an employee uses a home PC to work more efficiently or to make work easier.

There are two main IRS requirements for deduction of home computer business expenses. First, the home computer must be used for the "convenience of the employer." Second, the PC must be required as a "condition of the employment." In de-

termining whether home computer use is for the "convenience of the employer," the IRS focuses on whether work-related use is mandatory or optional, and whether employees who do not use

on a case-by-case basis. The IRS takes into account the employee's profession and position. Employer and employee requirements are also considered.

For example, in an IRS

to be nondeductible.

Although the school provided a modem for access to the school's mainframe computer and the home computer was used almost entirely for business purposes, the IRS reasoned that no evidence existed that people in this position who did not use computers for work were "professionally disadvantaged." According to this reasoning, the use of the computer was not for the convenience of the employer. Even though an employer may benefit from an employee's use of a home computer, a tax deduction may not be allowed.

In a different IRS letter-ruling, a process engineer in charge of computerizing quality-improvement projects participated in an optional, employer subsidized computer-purchase program. The

Employees who use their PCs for job-related work must be aware of recent IRS rulings and court decisions.

home computers are professionally disadvantaged. The IRS states that there must be a "clear showing that the employee cannot perform properly the duties of employment without it."

The test of whether these criteria are met is applied

letter-ruling issued to a college professor who was required to pursue independent research and develop external grant support to maintain her position, the business expenses associated with use of the home computer for these purposes were held

● TurboTax
● Andrew Tobias' TaxCut

In our last issue, we recommended *Andrew Tobias' TaxCut*, from MECA Ventures, and *TurboTax*, from ChipSoft. While the programs reviewed in this issue are all competent, none of them match the high standards set by *TaxCut* or *TurboTax*. *TaxCut*, with its artificial-intelligence component and emphasis on ease of use, remains an excellent choice for individuals who want to be led step by step through their returns. *TurboTax*, already an industry standard, is even better in 1989. It offers ample

power for individuals and for small-scale professional preparers.

Both *TurboTax* and *TaxCut* have been aggressively upgraded to reflect new developments in software and the tax code. Either package will greatly ease the pain of tax preparation.

Among the others, *TaxShop 1040* offers excellent graphics output and solid support for the IRS's fledgling electronic filing service. For those who insist on the Windows environment, *MacInTax For Windows* is worth a look.

purchase of the computer required that the employee meet certain productivity goals and the computer system itself meet certain specifications. The IRS reasoned that since participation was voluntary, the computer was not "inextricably related" to proper job performance and there was no professional advantage to the participants. Therefore, the computer was not used for the convenience of the employer and a business deduction was denied.

Although the IRS has been parsimonious in allowing home-computer deductions, the courts have provided some relief. If a proposed deduction fails the requirements that the employee use a home computer in performing his job or be "professionally disadvantaged," a tax deduction may still be avail-

able. In a recent court decision, a college professor was permitted a business deduction for use of a home computer although the computer was not a "condition of employment." The court ruled that employers need not explicitly require employees to use a computer. The "condition of employment" requirement was met so long as the computer substantially aided the employee in his job. Therefore, "convenience of the employer" may be construed as sparing the employer the cost of providing the employee with suitable computer equipment to engage in his or her job responsibilities. Based on these rulings and the court decision, an employee who wishes to claim a tax deduction for employment-related business use of a home computer must ensure that all of

TaxShop's well-conceived interview, informative help windows and pop-up instructions combine admirably to form an on-screen tutorial. The clearly written manual tells you everything you need to know about installation and operation, and gives you a rundown on each form and schedule covered.

An inexpensive (\$29) laser-printer driver may be *TaxShop's* greatest attribute. When used with a \$199 Center Piece Accounting & Tax font cartridge, the software turns a Hewlett-Packard LaserJet Series II into a veritable printing press. *TaxShop 1040* produces beautiful replicas of all the program's supported IRS forms. Even without the accessories and additional driver, the program generates a submittable graphics Form 1040 on a dot matrix printer.

Electronic filing is another up-to-the-minute asset. *TaxShop 1040* will prepare your tax-re-

turn data for electronic filing and the publisher, TenKey, will transmit it by modem for you for free. You simply place your W-2s, your signed electronic filing declaration (Form 8453) and a disk with your tax data file in the provided mailing envelope.

Add to this the availability of 33 state programs (not seen by us) at \$29 each from TenKey and *TaxShop 1040* starts to look like a lot of value for your money. It's also a good value for the tax preparer of simpler returns or the pater familias who constantly succumbs to flattery like "surely you won't mind doing my return too, please. It's so simple it'll only take a minute with your great big smart computer."

List Price: *TaxShop 1040*, \$69; laser printer driver, \$29; each of 33 state programs, \$29.

Requires: 512K RAM, two disk drives, hard disk required for electronic filing, DOS 2.0 or later. TenKey Publishing Inc., 7650 Municipal Dr., Orlando, FL 32819-9823; (800) 448-1415.

CIRCLE 617 ON READER SERVICE CARD.

Some Final Thoughts...

The tax-preparation software reviewed here and in the last issue satisfies a real need. With each passing year, tax-prep programs serve their function better and become more popular. Interestingly, it is the personal programs, not the professional packages, that are leading the way toward easier and more-efficient ways to cope with the anxiety of our annual fiscal ordeal. Some of the publishers of personal software have, in fact, branched out into professional software, offering batch processing, client instruction, and billing features.

If you haven't used a tax-return program before, this is a good year to give one a try. You'll be ready for next year, by which time the IRS should have figured out how to open electronic filing to anyone with a computer, a modem and a bank account or credit card. The IRS and the software publishers should simplify the tax reporting and payment process so that it is no more challenging than using an automatic teller machine. ■

the following conditions are met:

- Use of the computer is an explicit requirement of the employer
- Without such computer the employee is unable to properly perform his duties of employment, and
- The computer substantially aids in the proper work performance as an employee.

Since PC business-use deductions are a current tax issue, the facts and circumstances of each case must be examined on its own merits. Notwithstanding the constraints highlighted in recent IRS letter-rulings, tax deduction opportunities do exist, as evidenced in the court case. In determining whether the criteria for business use of home computers applies to an individual's personal tax situation, consult a tax advisor. ■

by
Bill Howard

Abort, Retry, Fail?

The Lighter Side of Personal Computing

IBM may use and distribute any of the information you supply in any way it believes appropriate without incurring any obligation whatever. You may, of course, continue to use the information you supply.

This section left intentionally blank—of meaning: Cautionary note at the bottom of IBM's Model 70 "Customer Response Form." Or could it be that even IBM can write a warranty card with tongue firmly in cheek?

Oh, Drat: Not Only Is the Computer Dumb, But the Modem's Running 200 Baud Slow

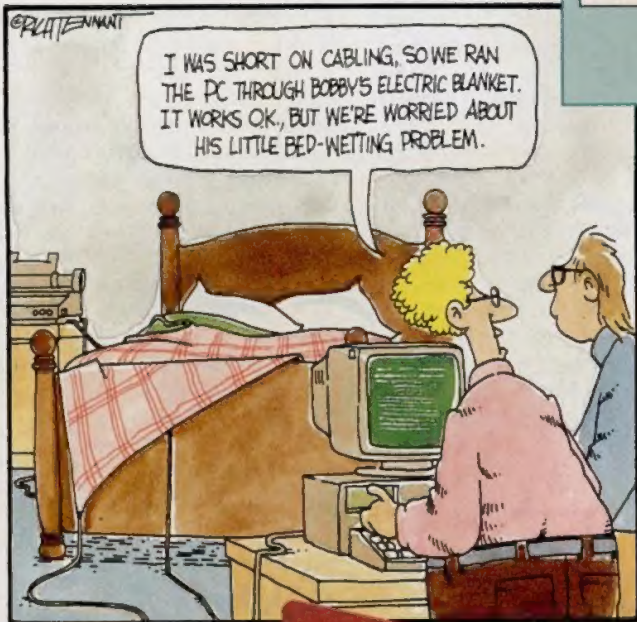
"When an agency signs up for [satellite distribution] service, says Lucht, it receives a dumb terminal desk computer and 9400 baud modem that hooks into a telephone line, so the agency can input traffic instructions on a standardized traffic letter."

—Screen, October 9, 1989

At That Speed, They'd Better Be Part of a Really Complex Instruction Set

"DEC officials also said that as many as 80 percent of VAX instructions on the VAX 9000 can be executed in one second, giving VMS customers a better perspective on the VAX architecture as compared with RISC systems."

—Digital Review,
October 30, 1989



Early leader in 1990's Nothing's Tasteless if Done in the Pursuit of Money sweepstakes: Tekservices Inc.'s Safedisk, a pair of "floppy disk condoms"—two pre-rolled plastic bags—designed to protect your disks against "Computer-Aided Invisible Data Sabotage."



Just in case you take advertising at face value, you'll be saved by the fine print in this ad for a Tranti computerized point-of-sale (POS) system in *Restaurant News* (November 13, 1989).

To see this system's best feature, hit it with a hammer.*



*Warning: A direct severe blow to any electronic equipment or monitor is dangerous and could cause injury.

According to this headline in *Chief Financial Officer* (November 1989), when multiuser accounting software on a LAN or minicomputer is "shared" by multiple users, it's called ... you got it.

SHARE-WARE

by Robert Mesquita

A critical look at the growing trend of multiuser accounting software on a LAN or minicomputer is "shared" by multiple users, it's called ... you got it.

PC Magazine gives you \$50 and a PC Magazine T-shirt if we use your submission in *Abort, Retry, Fail?* Warning: Don't write on the original if it might be reprinted; mark up a photocopy or use a Post-it. In case of duplicate entries, the nearest entry wins. Winners this issue: John Nettles (1-second VAX instruction cycle), David Jackson (IBM Customer Response Form), Jeff Darter ("hit it with a hammer"), Michael A. Stern ("Shooting Computers"), Laura Cohon ("Share-Ware"), Scott O'Brien (agency signs up for service).

Working Professional

by Michael Chiusano

Shooting Computers

"Warning: Firing a handgun at any electronic instrument or monitor is dangerous and could cause. . ." Wouldn't you expect to see some type of warning accompanying this article in *Shutterbug* magazine (November 1989)?

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(28-30)

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(28-30)

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Sell them at an even lower price

(28-30)

- 7) If you could make any changes or improvements to our products, what would they be? (Please list your top three suggestions)

Drop the Price /

(28-30)

- 7) If you could make any changes or improvements to our products, what would they be? (Please list your top three suggestions)

GIVE THEM AWAY FREE.

(28-30)

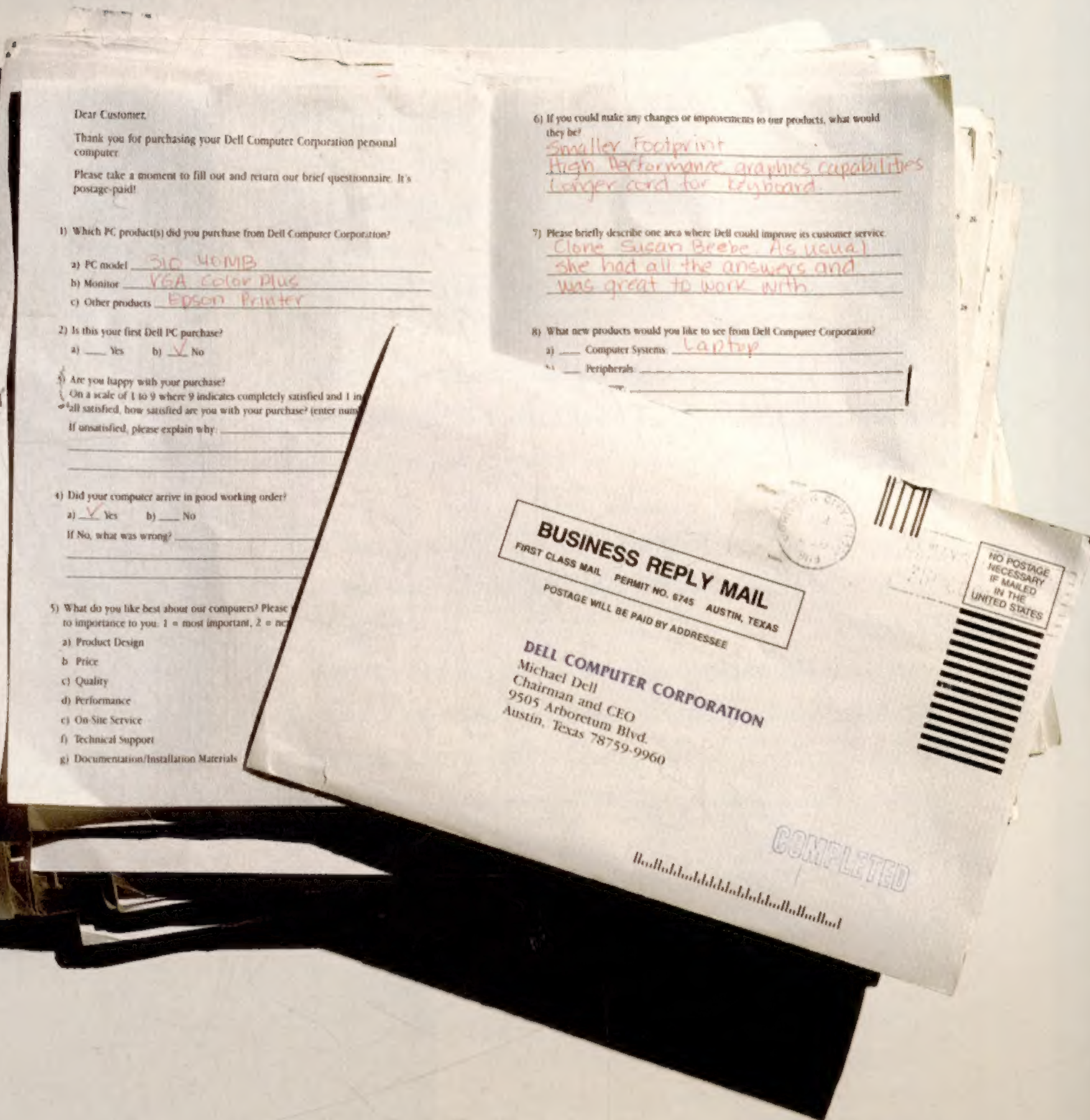
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